THE

MILLER'S, MILLWRIGHT'S

AND

ENGINEER'S GUIDE.

BY HENRY PALLETT.

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PREFACE.

THE demand for my previous work being so great and satisfactory, I have concluded to publish this second edition, with considerable additional information, and greatly improved and enlarged illustrations. I shall give more cuts and models of the different machinery now in use belonging to the Flouring Mills, than in my previous work.

As I have travelled through most of the States of the Union, I have had many opportunities of observing the different manner in which different millers manage matters in the mills under their care. And as many of them, from a confinement to a particular locality, have not had an opportunity of seeing Milling carried to a higher perfection than in their own locality, nor of observing the practice of millers more experienced than themselves, and who are anxious to improve themselves in their business, to such, I hope, this work will be of essential service.

And, in fact, to all millers, I think some of the instructions in this work will be of considerable use, as we are all never too old to learn. I have never as yet seen a work on Milling alone. Some remarks on the business are frequently to be found in the Millwright's Guide and Companion, which, however, are never very explicit; being generally intermixed with other matters, and with mathematical calculations and terms that are seldom fully understood by those who have had but a limited education. I have endeavored to avoid such terms, and have kept each part by itself, so that the most illiterate may gain information by a careful and attentive perusal of this work. It often occurs that millers will tell their employers that there is nothing in any work, treating on the subject of the Flouring Mill, but what they fully understand and comprehend; and from their talk the mill-owner would suppose them perfect in their business, and that there is nothing on earth that could give them the slightest or minutest information on the subject of milling. Now such a miller I always set down as bigoted in his opinion; and in fact knowing but little, as I have found by experience.

I have been assisted in the compiling of the

following pages by experienced millers, who have been kind enough to peruse them before going to press. I have also had the assistance of good and practical millwrights in relation to speed, construction of reels, etc., etc. The manner, the operation of the millstones, the action of the furrows, in cutting the wheat, can be readily understood by the transparent model attached to this work. From this part alone I hope considerable instruction and information may be derived.

I have written this work in the hope that it will be useful in assisting the workman in obtaining a true knowledge of the art of milling, and to assist him in making the calculations connected with the machinery of mills; and also the engineer will find a great many rules and examples to assist and instruct him in a further knowledge of his business as well as the millwright.

I am far from desiring that the rules contained in this work should be considered as an infallible guide, or implicitly followed in *all* cases; for when I reflect that it is to the workman that we have ever been indebted to for improvements in the arts, I would recommend to the miller, millwright, and engineer, a careful consideration of the many improvements that are daily taking place in

the Flour Mill, and study carefully whether their adoption would not be beneficial to this important branch of industry, as well in a public as in a private point of view.

In this work, my object is to instruct those who have not had an opportunity of judging the best ways of milling. I have endeavored to avoid unnecessary technical words, or scientific calculations, making no pretensions to literature myself. I have, therefore, aimed to make the work intelligible to those of the most limited education; with the wish, however, that it will induce them to a more careful study of the principles of their business; and I know of nothing more conducive to that end than combining the results learned from practice with a careful study of a good and practical scientific work.

Being aware that this subject might have been more scientifically treated upon by men more learned than myself, yet I feel confident that this work cannot be but a great benefit to many engaged in the business of milling; therefore I trust my humble efforts to please will meet with the approval of all such, and I now subscribe myself, respectfully,

HENRY PALLETT.

ST. LOUIS, *March* 1, 1866.

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THE MILLER, MILLWRIGHT

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EXPLANATION OF CHARACTERS USED—DEFINITIONS OF WORDS USED—UNITED STATES WEIGHTS AND MEASURES—DECIMAL FRACTIONS.

Explanation of Characters Used in this Book.

= Equal to. The sign of equality, as 2 times 4 = 8.

— Minus, or less. The sign of subtraction, an 8 — 6 = 2.

+ Plus, or more. The sign of addition, as 3 + 6 = 9.

× Multiplied by. The sign of multiplication, as 6 × 3 = 18.

÷ Divided by. The sign of division, as 9 ÷ 3 = 3.

: } is to
:: } so is . The sign of proportion, as 2 : 4 :: 8 : 16.
: } to

^{2} added to a number. The sign of a number squared, as 5^2 is 5×5.

^{3} added to a number. The sign of a number cubed, as 5^3 is $5 \times 5 \times 5$.

$\surd$ Prefixed to a number. The sign of square root, as $\surd 9$ is 3.

$\surd$ Prefixed to a number. The sign of cube root, as $\surd$ 27 is 3.

$\overline{\quad}$ Tne bar over a number. The sign used to signify that all the numbers under the bar must be taken together, as $\overline{8 \times 3} \div 6 = 4$; or, $5 \times \overline{6 + 4} = 50$; that is, $6 + 4$ is 10, and 5 times is 50.

DEFINITIONS OF WORDS USED IN THIS WORK.

Area—Plain surface: superficial contents.

Aperture—The opening by which water issues.

Angle—The meeting of two lines in a point.

Elastic—Springy.

Equilibro or Equilibrium—Balance of weight.

Friction—The act of rubbing together.

Gravity—The tendency all matter has to fall downwards.

Impulse—Any force communicated by power.

Impetus—Violent effort of a body inclining to move.

Momentum—The force of a body in motion.

Maximum—The greatest possible.

Percussion—Striking together.

Problem—A question proposed.

Radius—Half of the diameter of a circle.

Right Angle—A line square or perpendicular to another.

Theory—A speculative plan, but without practice.

Theorem—Position laid down as an acknowledged rule.

Tangent—A line perpendicular to or square with the radius and touching the circumference of a circle.

Velocity—Swiftness of motion.

Verge—The outside part: the outer edge.

Vertex—The top of any line or figure.

United States Weights and Measures.

AVOIRDUPOIS WEIGHT.

Avoirdupois weight is the only weight made use of in mechanical calculations; and all metals, save gold and silver, are weighed by it.

16 drams make one ounce.
16 ounces make one pound.
28 pounds make one quarter.
4 quarters make one hundred weight.
20 hundred weight make one ton.

LONG MEASURE.

12 inches make one foot.
3 feet make one yard.
6 feet make one fathom.
5½ yards make one pole or rod.
40 rods make one furlong.
8 furlongs or 1760 yards make one mile.
3 miles make one league.

SUPERFICIAL MEASURE.

144 square inches make one square foot.
9 square feet make one square yard.
30¼ square yards make one square pole.
40 square poles make one rood.
4 roods or 4840 square yards make one acre.

SOLID MEASURE.

1728 cubic inches make one cubic foot.
27 cubic feet make one cubic yard.

DRY MEASURE.

2 pints make one quart.
8 quarts make one peck.
4 pecks make one bushel.

LIQUID MEASURE.

4 gills make one pint.
2 pints make one quart.
4 quarts make one gallon.
63 gallons make one hogshead.
4 hogsheads one tun.

The dimensions of the United States standard bushel are $18\frac{1}{2}$ inches inside diameter, and 8 inches deep.

Decimal Fractions.

In decimal fractions, the integer, or whole thing, as a gallon, a pound, a yard, etc., is supposed to be divided into ten equal parts called tenths: these tenths into ten equal parts called hundredths: these hundredths into ten equal parts called thousandths, and so on, without end. So that the denominator of a decimal, being always known to consist of a unit, with as many ciphers as the numerator has places, is therefore never expressed—being understood to be 10, 100, 1000, etc., according as the numerator consists of 1, 2, 3, or more figures. Thus, $\frac{2}{10}$ $\frac{26}{100}$ $\frac{345}{1000}$, the numerators only are written with a dot or comma before them, thus, .2 .26 .345.

The use of the dot (.) is to separate the decimal from the common fraction. The figure on the right of the dot, known as the decimal point, is the place of tenths, the second of hundredths, the third of thousandths, etc. A cipher placed on the left hand of a decimal decreases its value in a tenfold proportion: thus .3 .03 .003 are 3 tenths, 3 hundredths and 3 thousandths.

SUBTRACTION OF DECIMALS.

Rule.—Write the less number under the greater,

placing tenths under tenths, hundredths under hundredths, etc.: then subtract as in simple numbers, and point off the decimal places, as in common addition.

Example.—Subtract 9.8067 from 10.5324.

Thus 10.5324 or 7.075 from 15.192

9.8067	7.075
00.7257	8.117

MULTIPLICATION OF DECIMALS.

Multiplication of decimals embraces two classes.

1st. To multiply together a decimal and a whole number.

2d. To multiply together two decimals.

Rule.—Place the figures the same as directed in the subtraction of decimals respecting whole numbers.

Example.—Multiply .125 by 9. Thus,

.125
9
1.125

Example.—Multiply .125 by 9. Thus,

.125
.9
.1125

Solution or Rule.—In multiplying decimals, place the factors under each other, and multiply them together as in whole numbers: then point off as many figures from the right hand of the product as there are decimals placed in both factors—observing, if there be not enough, to annex as

many ciphers to the left hand of the product as will supply the deficiency.

DIVISION OF DECIMALS.

Rule.—Prepare the decimal as directed for multiplication: divide as in whole numbers: cut off as many figures for decimals, in the quotient, as the number of decimals in the dividend exceeds the number in the divisor: and if the places in the quotient be not so many as the rule requires, supply the deficiency by annexing ciphers to the left hand of the quotient.

Example.—Divide 173.5425 by 3.75.

Thus, 3.75)173.5425(46.27.—*Answer.*

150.0

23.54

2250

1042

750

2925

2625

300

In decimals, the figures decrease from the right towards the left in a tenfold ratio. In duodecimals, where the dimensions are taken in feet, inches and twelfths of an inch, the foot is divided into twelve equal parts called primes, marked (′), each primes into twelve parts called seconds (″), each second into twelve equal parts called thirds, marked (‴), etc.

On the Selection of Mill Stones.

In the manufacturing of wheat into flour, it is necessary to have the millstones of the best quality, and most suitable for the different kinds of grain. Millers are of various opinions in the selection of their millstones—some choosing those that are open and full of pores; others choosing those that are close. I will present the following remarks and directions, for the guidance of those purchasing these articles; and although, on account of the diversity of opinion on this subject, I expect some may be found who will not altogether agree with me, yet I hope they will find some benefit in the perusal of the observations I make on the matter.

I would contract with the builder of millstones to make me a pair of the best quality, having the joints as close as possible. I would pick out a burr block of the quality I wished the stones to be made of, viz.: to have every one of the blocks the same as the one chosen for sample, and of the same temper. A stone that is made of part hard and part soft blocks is the most difficult of any to keep in a good face; neither will it grind well.

In selecting black burr for a pattern for the manufacturer, the best kinds, in my opinion, are those of a light color, full of small pores, and of a hard, sharp grit. The blue blocks I never could recommend in general; they are apt to glaze, and do not cut well: consequently it cannot be expected that they will grind as fast, or do as good work.

Have the eye of a stone of four and a half ($4\frac{1}{2}$) feet in diameter, ten inches on the face tapering to seven inches on the back. The thickness of the runner of this diameter ought to be nineteen inches in the eye and seventeen inches at the verge. Millers purchasing new millstones should not be too saving as regards their price. It is very bad economy to buy those of an inferior quality on account of their first cost being less than that of a good pair. When ordering new burr millstones from the makers, I would advise you to give orders for the builder not to put any spalls or pieces of burr block near the verge of the stone; the plaster shall be about three inches from the iron hoop, clear of spalls, on account of the balancing of the running stone. Often where cutting in the holes, to put in the lead, the small pieces of burr block as you have to come in contact with, by hammering on them, shakes the back of the stone, making it loose and worthless. Besides when balancing the runner you want to get the balance as near the face of the stone as

you possibly can. I have always found that the lead should be put as near the face block as possible for balancing the stone truly when at rest. When a standing balance is put at the top of the stone, often when running the balance will be imperfect. I believe when you can make a mortice close to the verge of the stone, nearly to the face block, it will be better than putting in boxes, for this reason—you may place your balance where it is required. When building a new pair of millstones the burr blocks of the runner should be nearly of one thickness; as they will not require as much trouble to balance them. Some of the millstone builders will put in blocks nearly twice the thickness of others round the verge of the face of the stone; when this occurs it is impossible almost, even when the irons are truly put in the centre, to balance them correctly; and putting in lead, if not close to the race of the runner, they will run badly, not being in running balance. The stone may be greatly out of balance when in motion, and this is the reason why the bush of some stones can only be kept tight a few hours. The reason why a stone that is balanced at rest will not sometimes be balanced in motion, is, that the upper part is heaviest on one side, and the lower part is heavier on the other side of the centre. The stone may balance at rest; yet when set in motion the heaviest parts draw outwards, most by the centrifugal force, which will put the

stone out of balance while in motion; and if the stone is not round the parts farthest from the centre will have the greatest centrifugal force. Never put too much dependence in having the stones perfectly true when coming from the makers. They are often taken from the burr shop without the staff being tried on their face. You must expect finding them in wind and having an uneven face. If they have been partially faced, it may have been for the purpose of breaking down the joints to make them appear small; and frequently when the stones appear too close they will use a heavy pointed pick to make them seem full of small pores; but as you straighten and smooth the face afterwards, these will disappear. You should therefore look carefully to see whether the pores are natural or not. When the stones are brought without a finished face being put on them, it becomes the miller's duty to work and face them ready for grinding; and to assist him in so doing he will find the following to be of service to him, if carefully studied and considered.

Of the Dressing of New Millstones—Making their Face Straight and Ready for Putting in the Furrows.

Lay the stone on its back, and level the face as nearly true as possible. Then with your staff,

having one of its sides formed by the edges of four boards made perfectly straight, true and painted, move it round the face of the stone, when it will leave the paint on all the highest places. These must then be picked off and the face of the stone rubbed hard with a sharp burr block. This staff should be made of mahogany; or if that is not to be got, it may be made of four (4) thicknesses of seasoned cherry or walnut one inch thick and four inches wide, planed on both sides, screwed to each other and glued together, so that they will not come apart. When made in this manner it will be four inches square; and by putting it together in four parts it will not be so liable to spring. Continue trying your staff, picking and dressing off the stone in this manner until the face is nearly smooth and straight. Then, in order to take it out of wind [technically termed] you fit a a piece of board in the eye of the stone; and from the centre you strike off a circle on the face, and about two inches from the verge. This circle you must again divide into three equal parts, which may be done as seen in plate 1st. In this circle or diagram the division of the parts is obtained by taking half the diameter of the circle, and stepping round its circumference. This divides it into six parts; every alternate point being taken, will give the three required. Then you must lay your staff on the inside of two of these points, and draw a line through them and out to

the verge of the stone; also, other similar lines from the points you have need and through the third point. These lines are all to be drawn to and fro, from the verge of the stone, and through the three points, thus forming an equilateral or triangle of three equal sides inside of the circle. Again, draw parallel lines about an inch farther from the first lines than the width of your staff. The spaces between these lines are called beds.

Now paint your staff lightly; lay its face upon one of these beds, and move it gently. It will leave the higher points painted, which must be picked off lightly with a sharp pick; then rub it with a piece of French burr block. Continue trying the staff and working in this manner until the staff paints the whole length of the bed, and it is nearly smooth. The other beds are to be worked in the same manner, avoiding taking any thing off the first, where they intersect one another, and being careful that the staff have an equal bearing at such intersection. When this is correctly done it is comparatively easy to make the face of the stone straight. Work down the other parts of the stone until it be even and level with the beds, which is best done by moving the face of the staff, painted frequently, over the face of the stone, dressing the higher points with sharp picks. This must be repeated, rubbing the stone with the block burr each time after picking it, being careful at the same time to avoid dressing

any more of the beds. When you have got the face even and straight with the beds, lay the staff without paint on the surface of the millstone, and look closely between it and the stone. If the light can be seen between them then the face is untrue; when you must again put a small portion of paint on the staff, lay it on the face, move it carefully all round, and pick the paint off lightly. Repeat this operation until it paints the face of the stone evenly all over. When the staff lies close and even on all parts of the face of the stone, without rocking, it is straight and even, and ready for the furrows putting in. Some millers are of the opinion that there is no necessity to put angles or beds on a millstone, averring that they can be taken out of wind, and made straight without them. As regards small stones, I admit this to be practicable—their surface being so small, they are easier made true than larger ones; but any stone whose diameter exceeds three feet can be more correctly and expeditiously dressed by putting in these beds according to the directions I have given.

Furrows: the Manner of Laying them Out: their Draft, and Cuttting them in.

From my own experience, as well as others respecting the draft and the number of quarters that should be made in a millstone, I think this is

one of the most difficult subjects I have yet undertaken—there being so many different opinions among millers with regard to draft, shape and size of the furrows.

I present the following directions for their assistance, hoping they will at least derive some benefit from a careful consideraton of them. First, I would recommend their particular attention to the quality of the millstones; the speed they wish them to run at; the quantity of flour they wish to make, and the different kinds of wheat they wish to grind. Some kinds of wheat are soft, and others hard, as *winter*, and *spring* wheat. The dress of the furrows of the millstone should, therefore, be made to suit—hard wheat requiring more face to the stone than the soft or winter wheat, Then to commence dressing a four and a half feet stone, you first put a piece of planed board in the eye, and even with the face of the stone. Then, in order to find the centre of the stone, divide the verge into four quarters, equally, lay the staff upon the face of the stone, and at the two opposite points on the verge make a line on the board in the eye of the stone. Move the staff to the other two points, and draw another line across the first one, on the board: if correctly done, where these lines intersect each other will be the centre. Then set your compasses to the draft you intend giving the furrows; place one point of the compasses in the centre, and describe a circle on the board:

this is called the draft circle. In laying off the quarters correctly, it is better to describe the circle within, and about three-quarters or an inch from the verge of the stone. This will enable you to divide the quarters off more equally than by making them on the verge of the stone, which is always broken and uneven. Divide the outer circle into as many quarters as you wish to have put in, making a point at each quarter; then with a furrow stick, made perfectly straight, and of the same width as you wish the furrows to be, proceed to lay off as the leading furrows, by laying it on the outside of the draft circle, having one edge at the centre, the other end and same edge of the stick at the point in the circumference of the circle for the quarters, making them or rather marking them with a quill, and point both edges of the furrow stick. If the stone is to be run with the sun, (as millers generally understand the term), you must lay your furrow stick upon the right hand side of your draft circle and quarter points, as shown in Plates 3, 4, and 5. If you wish to run the stone the other way, or against the sun, you must lay your stick on the left hand side of the draft circle, and quarter points, and proceed round the stone, as shown in Plate 6. After the leading furrows are laid off, it is better to step them all around to correct them, should any mistake have been made. Then if all be equal, take your land stick, which must be of

the width the lands are required to be, and is determined by the number of short furrows you put in between the leading furrows. Continue round the stone until all the furrows are laid off. It is needless to say they should all be of equal width. Then commence cutting in the furrows their proper width and depth. First use a sharp pick, making a straight mark on the lines of the furrows, the feather edge being but lightly marked. The edge of the furrow that is next the draft circle must be the feather edge, and that edge farthest from the circle, the back, or deepest part of the furrow. After marking the edges of the furrows, then with a heavy pick rough out the middle nearly the depth you want them, keeping the back part nearly straight from the face of the stone, and nearly a quarter of an inch deep, tapering up true to the feather edge. Then, with a sharp pick make them even and smooth the whole length of the furrows. The bed stone and runner are both dressed the same way. For a dress that will do for grinding both hard and soft wheat, the furrows should be laid off into thirteen or fourteen equal quarters, with three-quarters to each furrow, to be one and three-eighths inches wide, having the second furrows cut into the leading one, but leaving the width of the stick standing at the inner end of the furrow, (short), giving the leading furrow five inches draft, and making them a shade deeper at the eye. I would not recommend any

one putting in new stones to put in the curve or circle dress. All kinds of millstones that curve require more power to drive them than furrows that have no curve. The more curve or circle the greater amount of power you want to drive the stones.

To illustrate this subject more fully, take a millstone with a motion of one hundred and seventy-five or one hundred and eighty revolutions per minute, with furrows on the circle of one and a half the diameter of the stone. Then this stone has a draft at the eye, of the lowest number of inches generally given, being three and a half inches at the centre. As the pressure will be at least one-twentieth more than the straight dress, when the stones grind from twelve to fifteen bushels per hour, if one-twentieth of the power can be saved, then is it folly to use the circular dress, as the least pressure used in manufacturing, the better the flour after it is manufactured.

In this dress more time is consumed in keeping your stone in proper order. Besides, the skirt of the stone will wear lower than the breast or eye. The heat caused by the great pressure used becomes intense, which greatly affects the quality of the flour. These instructions refer to a four and one-half feet stone, making from one hundred and fifty to one hundred and sixty revolutions per minute, and burrs being of a close quality, or rather texture. If the stones are of an open

quality and full of large pores, I would not recommend so many quarters being cut in them giving them less draft. It is absolutely necessary in such cases that the stones should have plenty of face to enable them to clean the offal and do their work well.

Directions for laying off and cutting the Holes for the Balance Ryne and Driver.

The running stone being laid with its face upwards, and perfectly level, after fitting a planed board in the eye, you divide it into four equal quarters, and proceed to find the centre, as already described. In this case, however, the lines are drawn the whole distance, from verge to verge, through the centre. The mortices should be made nearly an inch longer and wider than the thickness of the balance ryne. The centre of this thickness wants to be in the line you have drawn through the centre of the eye, therefore the mortices must be set off, having this line through their centre. The object for making the mortices wider and longer than the thickness of the lugs is, that there may be room to wedge them, until they are in their right place. After cutting the mortices for the balance ryne the proper depth and size, you next proceed to lay off the mortices for the driver, on the two opposite quarter marks. There should be cast-iron

boxes for the driver to work in; and as iron will not wear as fast as the stone, the work, therefore, is better done. These boxes should be one-quarter of an inch wider than the driver, as it must have room to play, (see plate 2d), and the mortices for the boxes should at least be one-half inch wider than the boxes.

In order to make the mortices for the balance ryne and the boxes of the driver, good chisels and heavy ricks are required. First use a sharp pick to mark out each bed plain, so that you can make no mistakes afterwards from the painted marks wearing off. The sides of the mortices must be kept perfectly straight and square from the face of the stone. When you think the box-mortices are nearly of the proper depth, prove them by dropping the boxes in their place; and the driver on the spindle in its place, making it fast, so that it will not drop off. The balance ryne being then in its proper mortices, and they of the right depth, put the point of the spindle into the centre of the balance ryne, and the sides of the driver into their boxes. If the driver rides on the bottom of the boxes their mortices must be made deeper, as the point of the spindle should have a true bearing in the hole of the balance ryne, leaving plenty of room between the bottom of the boxes and the driver, required for play.

Directions for putting in the Balance Ryne, and the Boxes for the Driver, and making them fast.

The first way that this operation is performed is rather a difficult one, and is seldom resorted to by the practical miller. After seeing that your balance ryne is perfectly true in all its parts, and the hole for the cock-head punched exactly in the centre, as described hereafter in this work—then get a smooth strip of wood, the exact width of the lugs of the ryne, and thickness of the iron where the centre hole is punched in it, and fit it tightly across the space between the lugs, and even with that face of them that will be next the face of the stone, as in plate 7th; then lay a small straight edge on the lugs and over the strip; apply an iron square to the straight edge, with one blade at the centre point in the balance ryne, and make a mark on your strip, reverse your square, and if both points agree, that point is your centre; if not, divide equally the difference for the centre, and work it on the face of the strip accordingly. Then place the balance ryne in the stone, having the centre of the thickness of the lugs even with the quarter marks on the stone. Then lay a straight edge on the stone, and from the opposite quarter marks make a line across the mark you have on the strip; this will be the centre of the stone. Now lay your straight edge at the

other quarter marks, and move the balance ryne until you have the centre on your strip even with straight edge, which will then be in a line with the quarter marks *c*, *c*, in plate 2. And now if it agrees with the two other quarter marks *d*, *d*, the balance ryne will be in its proper place, and the centre of it in the centre of the stone.

Care must be taken to have the balance ryne perpendicular, otherwise the spindle wears out the hole to one side, and never can be made to run true; to prove this matter you place one blade of your square on the face of the stone, the other blade in the eye of the stone, and by moving it you bring the centre point of the balance ryne to correspond in every way with the centre mark on the strip of wood. This is done by picking in the bottom of the morticed beds or holes, care being taken to give the balance ryne a true bearing, so that it lies solid. Then drive small iron wedges around the ends and sides of it, leaving room for the lead to run in; which lead, after the sides of the mortices are stopped up with a stiff clay, is to be run in quite thin, and all around the iron, until it reaches above the surface of the mortices; it is then to be settled down closely with a cold chisel and hammer. The common—almost universal—way in which millers set the balance ryne to its centre is to make a sweep, thus: they take a strip of wood about two inches wide, and one inch thick, and of sufficient length to reach from the

centre of the balance ryne to the verge of the stone; and bore a hole through one end, into which they put a long pin and make it fast, the pin to be long enough to reach and fit in the pivot hole in the balance ryne, and the sweep to reach across the face of the stone: from repeated trials they get the balance ryne in the centre by measuring from it to the verge of the stone.

In setting the boxes for the driver, first put the driver on the spindle, in the proper way, and then place the boxes on the driver, having a piece of wood one-fourth of an inch thick under the bottom, and a piece at the ends, to prevent the driver touching either the bottom or ends of the boxes; then drive some wedges between the sides of the driver and the boxes to make the driver fast in the boxes. If this is carefully done it will have a good bearing on the side of the boxes, and will leave sufficient play for the driver; and then the wedges are removed, care being taken that no part of the driver touches the boxes, except where it drives; otherwise the stone will not run true.

If the holes of the boxes are of their proper depths there will be little difficulty now in setting the spindle. Lift it carefully into its proper place, putting the point into the hole of the balance ryne, the foot being at the top, and the boxes in their places; set the spindle straight, and put some wooden wedges on the side of and between the boxes and the sides of the mortices; then hang

the frame on the foot or under part of the spindle, the lower part of the frame reaching from the neck of the spindle to the verge of the stone. It should be about two inches from the face of the stone, and work accurately on the neck of the spindle—the top part of the tram to hang true on the foot or lower part of the spindle. Make a hole on the tram, about two inches from the verge of the stone, and therein fit a quill that will touch the face thereof. Let it play round. Turn the tram around also, and move the driving boxes until the quill touches equally and alike all round the face of the stone. When it does so, then is the spindle in its correct place, and the boxes must be fastened, after stopping up all the crevices round the boxes, in the eye of the stone, with stiff clay and running lead, as described for the lugs for the balance ryne. Be careful to mark the end of the driver, and the back or side of the stone, that it can always be put down the same way; then take out the spindle, as the stone is now ready for use.

A tram is made in the following manner: Take a piece of plank, two inches wide and one inch thick, the same length of the spindle; cut another piece about two feet long, three inches wide, and one inch thick; make a mortice through it of the same size as the long piece, and for one of its ends to go through and wedge tight, and to move the length you want it; and make a hole half through the other end, the same size as the foot of the

spindle, to hang on the foot, when setting the spindle in its place; take another piece of wood, four inches wide at one end, and diminished to one inch at the other, three feet long; cut half a circle out of the widest end, to fit the spindle neck, then nail it fast from the middle to the end of the long piece.

There are various ways now in use for driving the millstones—some being drove from the balance rim, and others in different ways. I will not give any opinion as to which is the best, not knowing. But I will say that I give the preference to the one which I have mentioned in this work. I can only say if any other way is used in driving the millstones they should be fitted up correct, otherwise the stones will not run well, doing but indifferent work.

Of Setting the Bed Stone, and Fastening the Bush therein.

Lay the stone down in the place prepared for it. The back must be placed on the timbers to lie even and solid, and then level the face correctly; this is done with a number of small wooden wedges between the stone and the timbers, by driving those wedges the most at the lower parts of the stone. When you have got the face of the stone perfectly level and lying solid on all the wedges, it should be fastened in its place by

driving wedges all around the verge, in order to keep it from moving sideways. Now clean the plaster out of the eye of the stone; sprinkle a little clean water on the plaster that remains, which will make the new plaster adhere better; then drop the bush in the eye, having the upper part one half inch below the face of the stone; place it exactly in the centre of the stone, by measuring from the verge and perpendicular, and put some wedges on each side, between the stone and bush, to keep it in its proper place; then with clay plaster up all crevices below, so that when the plaster is poured in to fasten the bush, it will not run through. I think plaster of Paris the best for this purpose—for this reason: Should the bush ever want removing, it can easily be done without breaking the stone; and if the plaster be good there is no danger of the bush getting loose. Mix the plaster with clean water until it be a little thicker than milk; then pour it all around the bush next the stone, until all the crevices are filled up. This must be done as quickly as possible after mixing up the plaster; if not done speedily the plaster will set and after it is once set it cannot be used again. When the plaster has once set hard, then put a board in the centre of the bush, and with a pair of compasses find the centre of the board, through which make a small hole; then put one end of a plumb line through it with the bob attached, and

reaching nearly to the step on the bridge tree; move the step so that the hole that is in it agrees with the point of the bob. When the step is in its right place wedge it up tight so that it cannot move. Now put the spindle in its right place, tighten the neck, and it is ready for tramming.

Every time afterwards when the runner is taken up to be dressed, the level of the bed stone should be tried and corrected if wrong. Almost all new mills will settle, and cause the bed stone to be out of level.

One word of caution about the neck of the spindle. It should have plenty of clean grease or tallow to keep it from heating; nor must it be made to fit tightly. It should be made so that it can be easily turned with the hand. If it be made to fit too tight, the neck will heat and expand when working; and when cooled after, will shrink, and the bush becomes loose.

Directions how to Bridge or Tram the Spindle.

First, take a piece of wood, four inches wide at one end, and diminished to one inch at the other, and from two to two and one-half feet long; make a square mortice through the widest end, of a size to fit the square on the cock-head of the spindle; make a small hole in the smaller end, and about two inches from the verge of the stone, and fasten

a quill therein, setting it to touch lightly and to play all round the face of the stone; make the tram, or piece of wood above described now fast on the square neck of the spindle; then move the spindle gently around, observing the parts of the face of the stone the quill touches. Alter the wedges or screws of the step towards the side the quill touches, and keep repeating this operation until it touches the face (equally) of the stone, all round, observing not to set the quill to touch heavy in any part, otherwise it will not be equal all round. When this is done the spindle should be in the centre of the bed stone. Millstones require tramming every time they are dressed: if they are not correctly in tram they will rub together, heavier on one part than the other, and make the flour specky and of a dark color. The spindle being now in tram, and in the centre of the bed-stone, it is ready for grinding.

Instructions for Grinding off the Lumps of New Stones, Turning the Back of the Running Stone, Rounding the Eye, and Balancing the Stone.

First, your running stone should be properly balanced, which may be adjusted in the following manner: Take off the driver, that the stone may have full play on the cock-head; then raise the spindle so that there may be room between the

stones to see the balance. Find the heaviest parts, and near the verge lay on sufficient weights to balance it. Cut a hole in the back of the stone, as deep as you can make it, and as near the verge as possible, that the binding iron hoops of the stone may keep the lead in its place. This hole should be wider at the bottom than at the top, to prevent its flying out with the motion of the stone; into which molten lead is to be poured, until it brings the stone completely into balance. When the lead is cold, the hole is filled with mixed plaster, even with the back of the stone. When this is done, take up your runner, and sweep the stone clean. Then place two pieces of one-half inch board, four or five inches broad, across the bed stone, and have the ends fastened in some manner to the floor. Lay the running stone, ready for grinding, lower the runner nearly touching the boards, then build a platform to reach across the back of the running stone, as near the stone as possible, without touching, and then start the mill briskly; and then with sharp chisels turn off the back smooth and even, and the eye round and smooth, as far therein as you can reach: which being done, take off the runner, and clean your stones and put it down again, ready for grinding. Put on your hoop around the stone, then start your mill gently—feeding your stones with a small portion of rye, or the screenings of wheat. Keep them running in this way for some

time, until the face of the stones becomes smooth—lowering the stones gradually, that they may run hard, having an unpleasant smell; so that when taken up the high parts of the face are polished and look glassy. Grinding off the lumps in the faces of the stones with water cannot be recommended, in consequence of its making the face of the stones uneven. For if there be any soft burrs in the stones it will wear them more than the hard ones. When you consider the mill has run long enough to polish the face, stop it. When this is done take up your runner and sweep your stones clean. You can now perceive whether the face of your stones has been truly dressed or not, as all the higher parts will be polished and shining. You will then have to use your staff, painted, as previously described. And by picking off the higher points, and rubbing with a burr block, and repeating the operation until the face of the stones is perfectly straight and smooth. Your mill will then be ready for grinding.

Directions for Dressing and Sharpening Millstones when they Become Dull.

Whenever the millstones become dull they have to be taken up and sharpened. In doing this, care is required, as well as in any other of the operations. When the staff is referred to, care

must be taken that the staff used be tested on a proof staff made of iron, there being but few mechanics who can make this instrument perfectly straight without the iron proof staff; and often very good millers make but indifferent work from using staffs that are not straight. With a straight staff try it then all over the face of the stone; if it lie solid without bearing on one part more than another then the face of the stone is true; if not, apply a little paint on your staff, and after moving it carefully over the face, thus marking all the higher points. These must be carefully worked off with sharp picks, and rubbed off with a burr block, as heretofore directed in this work, until the face is perfectly straight. You then again apply your staff, painted over all its surface, and wherever the paint appears you crack it lightly with the sharpest of your picks. These cracks should all be parallel with the furrows of the stone. Care is required to not make these cracks too deep, otherwise the stones will be rough, and not grind so well. Millers should also have a knowledge of the different qualities of the burr blocks the stone is composed of, when performing this operation, it seldom happening that all the blocks are of the same quality, texture, or hardness: consequently, in the harder blocks the cracks should be closer and deeper than in the softer ones. In performing the above operation, the part next the eye of the running stone, for a distance of from

four to five inches, should be dressed a little lower than the rest of the face of the stone. Frequently, in grinding, the stones become hot from being fitted too close next the eye. Millers should not resort to the operation of fleecing until the stones are badly out of face, as every part fleeced will wear much faster than the rest of the face of the stone. When the high parts upon the face of the stone are of but a small size, instead of fleecing them down, (technically termed), it is better to make them straight with the rest of the face by repeated cracking, taking the stones up occasionally for that purpose, until they become perfectly true or straight.

The furrows should be often dressed, keeping the feather edge sharp, and nearly even with the face of the stone, and marking off the furrows and lands with the furrow and land sticks; so that when dressed they will be of their proper sizes—their depth being carefully attended to at the same time. When not deep enough they will not grind so fast, and they are apt to heat the flour; and the bran will not come out so clean. When too deep, on the contrary, they are apt to throw out small parts unground. The furrows in every case should be a shade deeper at the eye than at the verge of the stone; and when they are dressed with the picks are to be carefully rubbed with a piece of burr block.

I would recommend the miller, when taking up

the millstones to be dressed, to have a bucket filled with warm water, wetting your stones; then with a scrubbing brush, with a little soap, scrub the face well, so that there will be no glaze left on them. You should have a large sponge, and soak the water off the stone, which will then soon be dry. The reason I recommend washing is, it opens all the pores in the stones, taking off the glazed parts. When the staff is tried on, there is nothing to obstruct its touching the face of the stone.

I have by experience found that when millstones have been grinding corn for some time, and then changing them for wheat, will not be profitable; as the oil in corn will penetrate in the burr blocks, causing them to be of a greasy nature; if they are cracked fine for wheat, these cracks will glaze, so that they will not clean the offal. I would recommend, before you commence grinding wheat, or changing them for wheat stones, to fleece off considerable of the face before using them.

It often occurs, that the millstones will, when grinding, throw out small round pieces, with parts of the meal ground too close. When such is the case it is evident that the stones are out of face, and working entirely on some high part. This prevents the stones running close enough to each other, which, if this is not the case, the meal cannot be ground equally alike. When this is the

case they should be taken up. If the face of the stones should prove to be true the furrows may be too deep and rough: if so, fill them up with some cement, that they may be their proper depth. For grinding corn, the furrows answer better by being a little rounding, and double the depth of the feather edge that is required for wheat.

Some millers are in the practice of letting their millstones run a long time without dressing them. But I am well convinced that those who dress them weekly will be fully repaid for their trouble.

Every mill should be supplied with a good grindstone; also, a piece of stone to rub the picks on, to keep them sharp, as dull picks should not be used, in any case, on the face of the millstone.

From my own experience, I think it necessary to give a few hints to millwrights and owners of mills in relation to the frequent alterations that are made in bolts, machinery, etc.; when the fact is, if the millstones were truly dressed these expensive alterations would not be required. Before making any alterations in the machinery, the millstones should be tested, their face properly dressed, and out of wind, their irons correctly fitted: all this should be carefully attended to before any alterations are made in the machinery. We are certain that when the millstones are in wind, or their face untrue, they must make bad work, the meal not being evenly ground. Keeping the stones true is the principal art of Milling; when

they are dressed truly there are but seldom any complaints made about the bolts or machinery. At times the face of the stones will be untrue, or in wind, which is difficult to be taken out by a miller unless he understands his business properly. Frequently when complaints are made with the bolts or machinery, a few days' work on the millstones by a practical, experienced miller, will remove all the difficulty, thereby saving a considerable expense. Often when a miller cannot put the millstones in good order he is almost certain to condemn the machinery; after altering the bolting cloths, if the mill still does indifferent work, he feels discouraged and leaves the mill, laying the blame on the machinery. If the miller who takes the management of the mill after him should understand his business, he will commence with the millstones and make them true. The consequence is the machinery and bolting cloths have to be replaced as they were at first, before the mill will do good work.

Respecting the Irons of the Mill.

In fitting up a mill, the miller, or millwright, should pay particular attention that all the iron work thereof be made perfectly true. The millspindle should be tested in the lathe before it leaves the shop, to see that the hole in the balance ryne, or point where the cock-head works in, be

punched exactly in the centre, and that the driver is made an exact fit of the square of the neck of the spindle, allowing, however, one-fourth of an inch from the lower face of the driver to the neck of the spindle for sinking in the wear. If these irons, in particular, be not correct in every point, they will give the miller a deal of extra trouble, and cannot possibly do their work as well as they ought.

If the mill be propelled by steam, the spindle requires to be much stronger than if by water-power, the power of steam being often quite unsteady. It should be of cast iron, from eight to nine feet in length from point to point, and the body not less than from fourteen to sixteen inches in circumference; the whole neck from ten to twelve inches in length, and from top of neck to point of cock-head nine inches—as the top of the balance ryne should reach, when in the stone, half way through the eye or more, thereby causing the stone to run better, it not being top heavy. The bottom and top or cock-head ends of the spindle should be correctly bored out, and their points ground in to fit exactly, that they may not change their position while running. These points are of course to be made of the best steel and well hardened.

When driven by water, which is always a steady power, the spindles do not require to be so long or so large as those described for steam

power. They are in general made of wrought iron, about five feet six inches in length, and their body two and one-half by three inches.

In testing these spindles, observe that the three points, viz., the point, neck, and step, correspond with each other; when they twist in any way the millstones are sure to run badly, and are apt to run bush-loose. After being tested the points should be case-hardened.

The balance ryne should be made in proportion to the spindle, and correct in all its parts; and the driver should in all cases be made perfectly straight and smooth.

The foregoing remarks apply to a four or four and one-half feet stone. If the stones are of less dimensions, of course the dimensions of the iron work must also be less; observing however that they be as accurately fitted up as the larger ones.

The boxes for the ends of the driver to work in ought to be cast a little rounding in the middle of the side, where the driver works in, that it may play easy, not touching the ends.

The pinion should be hung as near the foot of the spindle as it conveniently can, as the spindle will thereby run much longer without being bush-loose. The pinions should be larger; and as the friction will not be so great as on small ones the stones will run better

All the shafts in a mill should be of a sufficient size and strength to prevent either springing or

trembling while working, otherwise the rest of the machinery runs badly, and is apt to break.

When building a mill to be propelled by steam, care should be taken to have the first moving power, or wheel, that is hung on the rock or fly wheel shaft made large and heavy, as it will partly act as a fly wheel and keep the shaft steady. Its mate, or leading wheel, should also be heavy, the weight thereof keeping the upright shaft in its proper place. The main or larger wheels, that are of iron, whether leaders or drivers, to make them run even, should be done thus before using them. Every cog should be laid off and made true by chipping and filing them; as it is almost impossible, if they are not true, that they will ever wear true by running. Besides it takes more power to run them. By these precautions the stones are kept from jumping, when the engine is at high speed, which they are apt to do if these wheels are made light. In fact I never yet knew a mill to run well, or make good flour, if it had those wheels of a small size or light weight.

Very often wheels coming from the foundry are untrue and of an inferior metal, with the eye not placed in the centre. If bored out to fit the shaft, and this is not properly done, the wheels cannot possibly run true. When this occurs I would advise millwrights to send them back and get new ones. They are often used when not round, or

the centre being on one side, causing the machinery to run badly as long as these wheels last.

Often when the iron work is ordered at the foundry they will neglect cutting in the key seat of the wheels, to hang them on the shaft, not bestowing the time necessary. If these key seats are not correctly cut and the keys properly fittted they will get loose when running.

The seats should be level and smooth, and tapering a little, and the key fitted so that it touches the whole length of the seat. It may then be driven in lightly with no danger of it falling out when running. When building a mill, I would have all the centre of the wheels turned out, as they are better than the square eyes.

Every mill propelled by steam should have steel springs put on the pinion to take off the back lash of the engine.

Particular care should be taken to keep the upright shaft perpendicular, otherwise it takes more power from its pressing on the gudgeon, and disarranging the rest of the machinery. All the horizontal shafts should be perfectly level, and the upright shafts plumb; and it is evidently part of the miller's duty to keep them so.

Description of Plate 4, Showing the Principle upon which the Millstones Work.

Having heretofore explained the manner of dressing and setting millstones, and the arrange-

ment of the iron work connected with them, until they are ready for grinding, it becomes my duty now to point out the principle on which they act. And for this purpose I refer you to the Transparent Plate attached to this work. See Plate 4. By taking a perspective view through this transparency, attached to Plate 4, the angles and the furrows cross each other and are distinctly seen; and by moving it round you may form some opinion whether any improvement can be made in the draft of the furrows, etc.

I have given this Transparent Plate that millers in general may have a rule or principle to work from. It, as well as the Plates 3, 5 and 6, are drawn on a scale of one-half inch to the foot, from a millstone four and a half feet in diameter, having fourteen equal quarters, (technically termed), and three furrows to each quarter, and a ten-inch eye, giving to the furrows a five-inch draft. Plate 3, shows the plan of a bed stone, dressed, and lying ready for work. Plate 5, shows the running stone or mate of the bed stone ready dressed. From these plates, if carefully examined, I conceive the most inexperienced might commence and dress a pair of millstones without making any mistakes in laying out the draft, cutting the furrows, etc. These plates are drawn, showing the stones running with the sun, as millers understand the term. If you want to dress them the contrary

way—that is to run the contrary way—reverse the dress to the opposite side of the eye of the stone, as seen in Plate 6.

A great diversity of opinion exists among millers in relation to the draft and dress of millstones. Some think they should be dressed one way, and some another, which proves that this, the most necessary part of a miller's duty, is but imperfectly understood; and in general very many of them dress their stones from seeing others that have been in use, or making slight alterations therefrom, without knowing any thing of how the furrows cross each other, the work they have to do, or whether they will work better than those they are copying from or not. I believe the error within the last few years to have arisen from too much dress; viz.: giving them too much draft and making too many furrows. By this means they certainly can grind more; but the flour is liable to be heated, and the bran and offal to be made heavy—and you must afterwards use artificial means to make the offal clean; and when the stones grind too fast it necessarily follows that it requires extra power to drive them: whereas, if the stones are given less draft and not too many furrows to carry less feed, they will make cleaner offal, and the flour will be better, and not sour when kept. To illustrate this, I again refer you to Plate 4. You there see the exact manner in which the furrows cross each other, the back

of the furrows of the running stone running foremost, or vice versa, to the bed stones, acts like a pair of shears. When the furrows have too much draft this is not the case. On the contrary, they then drive out the meal or flour as soon as it gets into them, thereby making coarse middlings and ship stuff.

From my own experience, and by the advice and sanction of the most experienced practical millers I have consulted, the merits of the dress, as shown in Plate 4, cannot be too highly recommended. You there perceive that the furrows cross each other nearly at right angles, and that there is sufficient face or land left to do the work. I have already said that the principle of grinding is partly like that of the shears' clipping—the lands of the stones serving as guides to keep the grain in, and act as one edge of the shears, while the feather edge of the furrows and pores in the stone form the other edge. If these shears, therefore, cross each other at too great an angle they cannot cut. The reason that the cracks or strokes of the picks are made parallel with the furrows, is, that they act as a file to clean off the bran. By putting in a dress as shown in the plate, the face of the stones being straight and lightly cracked, and the furrows smooth and even, a four and a half foot stone will grind from ten to twelve bushels of wheat per hour without heating

the flour, and make the offal clean, and will not, therefore, turn sour by keeping.

Millers should take into account the velocity of the motion the stones run at respecting the draft. Where the motion is slow the draft may be increased with advantage, as the centrifugal force is not so great as to throw the meal out. And again the draft of the furrows can be corrected to a great extent by their depth; if the draft is not sufficient, deepen the furrows: whereas, if it be too great, let the furrows become shallower, taking care however never to let them become too shallow, as there should be sufficient room to allow them to cool or to admit air sufficient to carry off the heat generated by friction.

How to Fit a New Back on a Stone that has been Running.

When the back of the running millstone is not sound, but breaks and flies off in the running; or where the stone is not so heavy as you wish it, considerable loss of time, trouble of sending to the builder, and expense, are entailed. By following the instructions I give below, the same operation may be done at home, and the back made as good and sound as the builder could make it. It is as follows: You block the stone up with a block of wood, having its face down until it lies even, solid, and perfectly level; then pick and scrape off all

the plaster down to the face blocks, so that none remains but what is in the joints of the face blocks; then wash these blocks, and keep soaking them with water. There should also be a number of pieces of burr blocks, at the same time, washed clean and kept soaking. You then with a bucket half filled with clean water, and mixed with two tablespoonsful of glue-water boiled and dissolved, but not made so strong as joiners use it, mix in with your hand plaster of Paris until it be thick enough that it will not run, and breaking all the lumps, pour this on the stone, rubbing it in with your hand—the stone being at the time damped; and place small pieces of stones all over the joints of the face blocks. You then, with more plaster, mixed in the same way, but made more stiff, with this and pieces of burr stones, build walls round the eye and verge, four or five inches high, leaving the surface uneven and the eye larger, as it will be brought to its proper size by the last operation. It is better to build up the wall of the running stone round the verge for three inches without any spalls, so that the holes may be cut in to balance it. If you then wish to make your stone heavier, you take pieces of iron (broken into small pieces, well washed and perfectly clean; for if there be any grease on this iron, the plaster will not adhere to it) and lay them evenly all round the stone, in the place between the two walls just built; and with plaster mixed a little thicker than

milk, pour in under and through all the crevices in the iron until the surface is nearly level with the two walls. If the stones do not require additional weight added, instead of iron, use pieces of stone in the same way, leaving the surface rough and uneven. Again, you, as before, build walls round the verge of the stone, and round the eye of the stone, until they are within two inches of the thickness you want your stones to be, the wall round the eye being two inches higher than that round the verge, and filling the space between these walls with stones, and pouring in plaster again, make it nearly level with the walls, but leaving the surface rough and jagged, to make the next plaster adhere well to it. You now let it stand until the back is dry and perfectly set, when you raise the stove upon its edge, and with a trowel, plaster round the edge of the stone neatly, giving it a taper of half an inch from the face to the back of the stone. When cased round in this way, lay the stone down on the cock-head, it being in the balance ryne, but the driver off; then raise the spindle, and balance the stone as already directed before putting on the remainder of the back. You then have a tin made the size of the eye, and to reach from the balance ryne to the thickness you want the stone to be at the eye. This tin should be exactly fitted to its place, and made fast; then fit a hoop of wood or iron round the verge, having the upper edge the thickness from the face you

want the stone to be at the verge, and equal all round. This hoop should be greased, and all the cracks round it, and the tin in the eye being stopped, you pour thin plaster (having more glue-water than in operations before performed, to prevent it from setting so quickly, and to give time to finish the back correctly) until it be level with the hoop round the verge, and with a straight edge, one end resting on the hoop, and the other end resting on the tin at the eye; then, by moving it round, and working the plaster with a trowel, make the surface of the back even and smooth between these two points. The hoop is then taken off, and the back and the edges planed smooth. Then lower the spindle until your runner lies solid, and put your band or hoop on, it being first made nearly red hot, and taking care that it is of sufficient size not to require too much driving; if fitting too tightly it may loosen the back in driving it to its proper place. It may be cooled gently by pouring water on it, and when cool it should fit tight. It is necessary that there be plenty of help in this operation, as it requires being done quickly; and care must be taken to have the best plaster of Paris; for if the plaster is not good, the back cannot be made sufficiently sound.

Of the Elevator, Conveyor, and Hopper Boy.

Every mill should have the following machinery attached to it, viz: the elevator, conveyor, and hopper boy (a description of which I subjoin), which will perform nearly every necessary movement of the grain and meal, from one part of the mill to another, or from one machine to another, through all the various operations, cooling the flour and so forth, from the time the grain is emptied from the wagoner's bag until it be completely manufactured into flour, whether it be superfine or of other qualities, and separated ready for packing into barrels for sale or exportation—the whole propelled by the motive power of the mill, very little being required to drive them, —thus lessening the expense of the attendance, etc., on flour mills considerably.

THE ELEVATOR.

The elevator is an endless strap, revolving over two pulleys, one of which is situated at the place where the grain or meal is to be hoisted, the other where it is to be delivered. To this strap are fastened a number of buckets, which fill themselves as they pass under the lower pulley, and empty themselves as they pass over the upper one. To prevent any waste of grain or meal, which might spill out of the buckets, the strap, buckets, and

pulleys, are all enclosed, and work in tight cases. The straps should be made of the best leather or gum belting, well stretched, and having strong buckles sewed on one end, that it may be made tight in the event of it becoming loose. The buckets are made of sheet iron or tin, not quite so wide as the strap, and fastened thereon, having an equal space between each bucket, and placing them from twelve to fifteen inches apart. In fastening them lay your square on the leather strap, holding one edge true with its edge, and mark it straight across; then, with the edge of your bucket to this mark, punch it, and fasten on your buckets.

It is best these buckets should be large, without being crowded, and made of the best material, such as sheet iron or tin. When made of tin, be sure they are made of the thickest and heaviest you can find. If made of light tin, they will last but a short time. I prefer putting them on the belt with screws instead of rivets; for this reason: when any one needs removing, the old one may be removed without injuring the belt. The proper way to put the buckets on the belt, is with stout screws, about one inch long, and with sharp points. Make your holes in the bucket, then lay one of them on the belt, and with a sharp point make a mark, and punch these holes through the belt the proper size for the screws. Cut some thick leather about one and a half inch square, put the screws

through the belt and bucket into this leather which is inside of the bucket, and screw them tight. If the belt runs straight without rubbing on its edge, the gum belt will answer as well and last nearly as long as leather, costing considerably less. This strap and buckets are made to revolve with sufficient rapidity to carry the grain or meal requisite.

The pulleys for the elevators should be at least twenty-four inches in diameter, and about one inch thicker than the width of the belt, and nearly half an inch higher in the middle than at the sides, to make the strap keep on. These pulleys should have a motion of twenty-five revolutions per minute. The buckets should be about fifteen inches apart. One hundred and twenty-five buckets will pass per minute. They will carry one hundred and sixty-two quarts, and hoist three hundred bushels per hour. If this is not fast enough, make the strap wider and the buckets larger, increase the velocity of the pulley (not to be above thirty-five revolutions per minute), nor place more buckets than one for every twelve inches, or they will not empty.

THE CONVEYOR.

The conveyor is an endless screw of two continued spirals, put in motion in a trough. The conveyor has eight sides to its shaft, set on all sides with small inclined boards, called flights.

The shaft should be made of yellow pine, which is light, and the least liable to spring. It should make from thirty to thirty-five revolutions per minute. The flight can be made so that the grain or meal may be conveyed and run out at any part of the trough; or be altered to drive either forward or backward; and when the flour is full of specks, the miller can, by altering the flights in the flour chest, cause the flour to be brought back to the return spout, to be bolted over again; the conveyor, therefore, is one of the most useful parts of machinery in a mill. Wheat may be run into several garners or binns from one conveyor, holes being cut in the bottom of the trough, and slide attached with spouts under each hole, and having the flights so arranged that the wheat will run out at any part of the trough into any of the binns; and should the miller want to separate the different qualities of wheat, he can do so by altering the slides, allowing the wheat of a superior quality to run into one binn, while that of an inferior quality runs into another; or he may mix them, by allowing both to run into one binn, as he thinks proper.

THE HOPPER BOY.

The hopper boy consists of a perpendicular shaft having a slow motion (not above six or seven revolutions per miuute), carrying round with it a horizontal piece of wood called the arm

or rake. In the centre of this arm or rake, a hole is made large enough for the bottom end of the shaft to work easy in, and to rise and fall as required from the accumulation of flour in the hopper boy. The under side of the rake is set full of small inclined boards called flights, so as to gather the meal toward the centre, and to the part or hole that feeds the bolt.

At this part a board is set broadside foremost, and fastened to the rake, which is called the sweeper, and which carries the meal before it until it drops it into the shoe leading to the bolt or bolting cloths, while it passes over it. Thus you perceive, that as the meal falls from the elevator it is spread out to cool and mixed together at the same time.

There are two other arms put through the shaft and near its top, to the ends of which, and to the ends of the rake, a line or lines are attached to help to carry it round. Near the upper end of the shaft, also, there is a mortice cut in which works a small pulley. Over this pulley is a line, having one end attached to the rake, the other to a weight, that the rake may work more easy, by rising and falling in proportion to the feed in the hopper boy, as sometimes the meal will not bolt so fast as it is ground; while again you may want to stop the bolts without stopping the mill; for when the meal bolts too freely the flour is apt to be full of specks. It is better, therefore, to let

the meal accumulate in the hopper boy, until there is sufficient to give the bolts a heavier feed. The shoe that feeds the bolt should not be less than twelve or fourteen inches long, as it will then supply the feed more regularly than if shorter.

Of Bolting Reels and Cloths, with directions for Bolting and Inspecting Flour.

Bolting being one of the most important parts of milling, I would observe that the attention of the miller should be particularly directed to the construction of the bolting chest, the reels, and every thing appertaining thereto, taking into consideration the duties they have to perform. I present the following remarks (being what I consider necessary for a mill making from one hundred to two hundred barrels per twenty-four hours) for his guidance; and although they may not suit in every instance, I flatter myself they will be found to answer a general purpose, and assist him, should he be so situated as to have to make some deviation therefrom, as they will enable him to form some idea of what alterations his circumstances may demand.

Two superfine reels are necessary for a mill of this capacity, to be twenty feet long and thirty-two inches in diameter each, running at the rate of thirty or thirty-two revolutions per minute,

and covered with No. 10 or 12 cloth. Under these reels, and to receive the stuff from the first two, are placed two other reels—called return reels—covered with No. 10 cloth. And still again under these are placed two more; one reel for middlings, covered with No. 5 cloth, and one for a duster, covered with No. 10 or 12 cloth—all to be of the same length, diameter, and running at the same speed as the first two described. As these reels are constructed with six ribs, they consequently have six sides when covered. The diameter of the best sized reels is thirty-two inches, as stated above; the circumference will be three times that diameter, or ninety-six inches. The bolting-cloth is forty inches wide; one width, therefore, should be ripped up into three equal widths, each of which will be thirteen and one-third inches wide. It will consequently take two widths of forty inch cloth to make six of these narrow widths. From the centre of one of these ribs to the next, is half the diameter—that is, sixteen inches. These six widths (thirteen and one-third inches) must then be sewed together with a strip of bed-ticking between them, which bed-ticking will come on each rib. These strips of ticking must be of an equal width (about three inches), as the width of the whole six must not exceed the difference between the six narrow widths of the bolting-cloths and the circumference of the reels. When you have sewed all the seams

of the bolting-cloths, then sew a strong piece of cotton cloth or bed-ticking, about six inches wide, and long enough to go round the reel at the head, and a piece four or five inches wide at the tail—these pieces being to fasten the cloth to the reel. Cover the outer edge of the ribs with strips of cotton cloths, about one and a half inches wide, to prevent the cloths from wearing through by rubbing against the ribs; then put your cloth on the reel, which is made to go on tight, and fasten it at the head and tail ends with small tacks. It is a general remark with millers, that they have not sufficient bolting-cloth for cleaning the offal, especially when the wheat is damp, as it requires more cloth than it does when it is dry. In fact I never saw too much in any mill. It is generally when new mills are built, after running a short time, extra reels have to be put in. When the wheat is perfectly dry stop off part of the feed of some of the bolts, or stop some of the bolts entirely. When the wheat is dry you require a heavy feed in the bolts, otherwise the flour will be too specky for the market. The reels should have a fall of half an inch to the foot, and movable bridge trees to raise or lower them at pleasure. Sometimes large reels are put in, forty-two inches in diameter. I have used them, but find they will make the flour full of specks; therefore I cannot recommend them.

When used, their speed should not be more than twenty-five revolutions per minute.

The bolting chest should be made having sufficient return slides, so that you may alter them to suit. The miller who has had any experience in the business, can at once perceive by taking some of the flour in his hand, and smoothing it with something having an even surface, whether it is too full of specks or not to be saleable in the market; if it is too full of specks, then he can open some of the slides, that it may be returned and bolted over again. Should the flour appear darker than what might be expected from the quality of the wheat, it shows either the grinding to be too high, the bolting to be too close, or the face of the stone not truly in dress; because, the finer the flour the whiter its color.

Bolting reels for a small country mill where the mill does not grind more than five bushels per hour, or, as is generally the case, in small parcels, a reel sixteen feet long is sufficient, to be covered ten feet from the head with No. 9 cloth, and the remaining six feet at the tail end covered with No. 6 cloth. If more than this quantity is ground you will require more reel and cloth in proportion to the quantity.

By putting the cloth on the reel, care should be taken to have every seam on each rib of the reel, so that when the cloth is finished it will be stretched tight, without any wrinkles to be seen

the whole length. When putting on your cloth, it is best to stretch the ends of the cloth, to bring them as near their place as you can, putting in a few tacks to keep the ends from moving. Then with a small needle, such as saddler's use for their fine work, with some fine flax thread waxed with bees-wax, sew it. Let this seam be made on the top of one of the ribs. Be careful to draw this seam tight, so that the cloth is perfectly stretched. When your seam is finished stretch it lengthways, so that the creases are all out. Fasten it at the head and tail ends with some small tacks.

Directions for Cleaning of Wheat.

It is necessary before grinding, that wheat should be well cleaned, and all impurities taken out of it so far as possible; otherwise the flour will be of a dark color and full of specks. I will give a few directions necessary to be observed in this matter.

In the first cleaning the seed should be attended to so that there be no obstructions, as the feed should be as regular for the machinery as for the mill-stones. It is almost impossible that the wheat can be made clean unless the feeding be properly regulated.

First it should be elevated to a shaker, which should be made use of to remove and take out

rat dung, oats, and small sticks, and every thing that is longer and larger than the wheat. This shaker is a frame (of wood) about four inches deep, eighteen wide, and about five or six feet long, the bottom being of sheet-iron. At the distance of two feet from the top end, holes are punched for two feet six inches in the length of the screen, leaving one foot six inches at the lower end not punched. These holes are punched just large enough for the wheat to pass through, while the sticks, rubbish, etc., pass over them and out at the lower end. This shaker should be set on an incline, and so that you can raise or lower the tail end at pleasure; and the crank should not be more than one-half or three-quarters of an inch in diameter, and making from one hundred and twenty (120) to one hundred and fifty (150) revolutions per minute. This should be made to work easy without jumping, for if it does the sticks will fall through in the wheat. It is necessary to have a small blast of wind carried under the bottom of the sheet-iron; this will assist to take out all the impurities from the wheat. From this shaker it should run into a large suction-pan, which will take out the small wheat and all other impurities. This will bring it to the proper state for cleaning for grinding.

You then elevate the wheat to the smut mill to be well scoured, in order to break any smut or dirt that is not taken out, and also to rub the fuz

off the wheat (the smutter should run at the rate of from six to seven hundred revolutions per minute); it is then run from the smutter to the suction-fan, so if any dirt is left in the wheat it may be taken out, or it will make the flour of a gray color.

This suction-fan is represented by Plate 9. The drawing as given in the plate shows both a suction-fan and grain separator—scale, half an inch to the foot. It is a good machine, cleans and separates well, weighing the grain by its specific gravity. The wheat enters near the bottom of a tapered spout, and falls on a piece of wire screen; the wind is sucked into the fan from underneath the wire, lifting the wheat up the tapered spout, but as it rises the spout gets larger, and the wheat accumulating stops the draft. The good wheat is discharged by the side of the wire, while the light is carried over into the hopper, where the air expands more, and allows it to fall out at the opening at the bottom of the hopper, where there is a spout to a valve attached. The chaff is discharged through the fan; the motion required is six hundred revolutions per minute. The wheat is then run from the suction-fan into the stock hopper, and is then ready for grinding.

Screens have until recently been greatly in use. A great many mills are doing away with them. I do not think them of much utility in a flouring

mill, as they take a great deal of room; besides filling the room with dust and dirt.

I will give some instructions to those who would like to use them. These reels should be made about ten feet long, eight feet to be covered with No. 10 wire from the head end, the remaining two feet of the reel to be covered with No. 4 wire. This reel should be about thirty inches in diameter, and running about twenty-two revolutions per minute. After cleaning the wheat there will be dust in the stock hopper when nearly empty, which should be taken out. This can be done by using a small suction-fan. This instrument is easily made, costing but little, as almost any mechanic can build it, The length of the whole not being more than four feet, its breadth about the same size as the fan, where there is a silent feeder it should have a frame made to stand on the hoop, similar to the hopper ladder.

I believe, although its small appearance, it is a very useful machine, and will be generally used; there is a spout attached for a bag to hang on; this secures all the dust or dirt from going in the mill. For a small country mill, where there is not sufficient cleaning apparatus, they will be a great benefit. The fan is driven from the spindle of the stone. The pulleys should be made to drive the fan eight hundred revolutions per minute.

Instructions for Grinding Wheat.

In grinding wheat into flour, the end we have in view is to reduce it to such a degree of fineness as is proved from experience to fit it to make the best bread, and to put it into such a state that the flour may be most effectually separated from the bran or skim of the grain by sifting or bolting. Having, therefore, your stones dressed and ready for grinding, and your wheat well cleaned, you start the mill gently, putting the power on gradually, until the full power that is required is on. The feed should be put on in a similar way. Then lower your stone down gently, until the meal feels soft and even. As to the quantity of feed a mill should have, I can lay down no rules to follow, and therefore it must be left to the miller's own judgment; observing, however, that where the feed is either too great or too small, the stones cannot do their work; and it is here the experience of the miller is called into requisition, in regulating the feed to suit the speed the stones run at, and their state for grinding. To the inexperienced I beg to offer some hints for his guidance in this matter, viz: Catch some of the meal as it falls from the stones, and feel it between your finger and thumb; if it feels even and smooth, not being greasy, and the motion of the stones being right, it will then bolt well and make good

flour. If the meal feels coarse, or the stones run too slow, take off the feed, and keep altering until they do good work and run their proper speed; while again, if the meal feels greasy, raise the stone a little, regulating your feed to suit. It requires practice to be enabled to judge of the requisite fineness of the meal; as a general rule, however, it cannot be ground too fine, provided you have sharp stones and the feed properly regulated. Some think that by grinding too fine you destroy the life of the flour, as it is called.

It is not the fineness that destroys the life, but the heat produced by too great a pressure, from the stones rubbing together when grinding, as nearly all the flour may be taken out of the wheat which will pass for superfine. Millers also require to pay particular attention to the grinding and bolting, with regard to the different qualities of wheat This needs repeated watching, some lots or parcels being soft and damp. In these cases, less feed is required than when the wheat is dry and hard. If damp wheat be ground with a heavy feed, the bran will not be cleaned, nor the flour so good. Neither should it be ground with dull stones; in that case the meal will be clammy, and stick to the cloth, thus preventing it from bolting freely; besides, it prevents its rising in baking. Damp wheat requires as little pressure as possible, and this cannot be done with dull stones. To test the matter, hold your hand near

the spout, and catch some bran as it falls from the stones, and separate it from the flour; if the bran feels soft, and is clean, and of an even thickness, then are the stones sharp and grinding well. While again, if it is not clean, and cut fine, alter your stones; and if that does not alter the quality of the bran, the fault lies in the furrows, or the face not being true, but rough and uneven. If the stones grind too hot, it is often caused by the stones being too high round the eye, or the furrows not being of sufficient depth. Catch a handful of meal as it falls from the stones, and shut your hand quickly; if the meal will fly out and escape between your fingers, it proves it to be in a lively state, the stones sharp, and it will bolt well; the greater the quantity that remains in the hand, the more faulty will be the flour.

If the face of the stones are untrue, some parts being higher than others, these parts will rub harder, thus causing a heavy friction, and making the flour of a dark color, and full of specks, and keeping other parts of the stones too far apart, thus causing too much middlings to be made, and not cleaning the offal. When the stones get too close, and rub together, so that the meal feels greasy, they ought to be taken up and well cleaned. If continued running in this way, the face becomes polished, the furrows fill up, and no air can pass in or through the stones to carry off the heat generated by the friction in grinding. If

the bran is uneven, some being thick and white with flour, and some clean and cut up into small particles, or if the grain escapes grinding, there is evidently a defect in the stones. Sometimes the furrows may be too deep, the face not straight, or it may be a low part in the face of the stone. It then requires that a miller, on watch, should have nothing else to do than attend to the regulation of the feed, the working of the stones, and the rest of the machinery, and to do this properly in a large mill, is as much as one man can attend to.

It is requisite that the stones of a mill should be taken up and dressed every week, when running night and day. Some, indeed, let them run longer; but in that case they cannot grind so well, nor will the flour be so lively, nor the bran so clean. Indeed, the difference will fully repay the trouble and expense of dressing, as, after dressing, the bran is so much cleaner and larger. A great oversight by many millers, and one where the interest of their employers is not studied as much as it should be, is grinding too fast; the flour is thereby heated, the yield is deficient, and the offal not so clean. A four and a half feet pair of mill-stones, properly dressed, and making one hundred and sixty revolutions per minute, and driven with sufficient power, ought to grind not more than from ten to twelve bushels of wheat per hour to make clean and good work.

Directions for Grinding Wheat with Garlic amongst it, and for Dressing the Stones suitable thereto.

In many parts of the country where wheat is grown, there is a species of onion, called garlic, that grows among, and spontaneously with, the wheat. It bears a head like that of a seed onion, which contains a great number of seed about the size of a grain of wheat, and nearly as heavy. If the wheat can be laid by two or three months in the sun, or if well dried, the garlic will shrink, and then a great part of it may be blown out with the fans, or will fall through the screens. It is, however, nearly impossible to separate it completely. The smaller and lighter may be got rid of; but where the grains are of the size and nearly the same weight as the grains of wheat, it is a very difficult matter to make a separation. It is sometimes done by putting the wheat in water, when the wheat sinks, leaving the garlic on top. But this is too tedious a method, and takes too much trouble afterward to dry the wheat, and make it fit for grinding; therefore, a portion of garlic must necessarily be ground with the wheat. It is of a glutinous nature, and adheres to the stones, and gums them over in such a way as to dull the edges that they will not grind. When this is the case, the running stone must be taken

up, and the garlic washed off the face of the stones with hot water, scrubbing them with stiff brushes, until the faces are perfectly clean, and dried up again with a sponge or cloth. This has to be repeated two or three times in twenty-four hours' grinding, if there is much garlic amongst the wheat.

Directions how to put the Stones in Order for Grinding Wheat that has Garlic amongst it.

Put some paint on your stone-staff, and move it gently round the face of the stone. Where it marks, it should be cracked heavy and closely; where there is no paint, a light cracking will do. The face of the stones should be left rougher than for grinding wheat free from garlic, on account of the garlic being of such a glutinous nature; also, keep the face of the running stone lower around the eye, that the grains of the garlic break less suddenly, thus giving it more time to mix and become incorporated with the meal, which prevents it from filling up and gumming the cracks in the stone. The rougher the face of the stones are left, the longer they will run.

Having, however, taken all the precaution and care that you can, if there is much garlic in the wheat, the offal will be heavy, and the bran not

well cleaned. The bran and offal, however, may be ground and bolted over again.

Mill owners should be cautious about buying wheat for grinding having garlic in it, if they can possibly avoid it.

Directions for grinding Middlings, and how to prevent the Stones from Choking, so as to make the most of them.

After the wheat has been ground in the best manner you possibly can, there will yet appear in the bolting a species of coarse meal, called middlings, of a quality between superfine and shorts, and which is frequently made into coarse bread. But as the meal in this state sells at a low rate, it is more profitable to grind it over, so that the superfine flour that is in it may be taken from it, and disposed of to a greater advantage than what the middlings will sell for.

If there are more than one pair of stones in the mill, the better plan is to run one pair for middlings, and the other with poor wheat, so that both can be bolted together, which will be of advantage to the middlings, as they require bran among them to prevent the bolting-cloths from clogging, and it will bolt cleaner and better. There should be a rod put through the bar that supports the upper end of the damsel, the lower

end reaching inside the eye to the balance ryne, to prevent the middlings from sticking to the eye of the stone, so it cannot feed.

If there are but one run of stones in the mill, and you want the middlings made into superfine flour, you can, by a little simple machinery, run them into the eye of the stone, and grind them with the wheat; therefore, both will be bolted together.

Be careful to avoid too much pressure when grinding middlings by themselves, as there is then not bran to prevent the stones from running too closely together. If the stones are run as close as when grinding wheat, the flour will be killed; while, if it be pressed but lightly—that is, the stones kept at the requisite distance, the flour will be lively, and make good bread. When middlings are ground by themselves, it will be necessary to add some bran in the bolting; the bran prevents the bolting-cloths from choking, thus causing it to bolt more freely and cleaner. If ground and properly bolted, there will not be any thing left after to pay for grinding, or doing any thing more to it. It will be fit only for feed.

Every mill that is making from one hundred to two hundred barrels of flour in twenty-four hours, should have a pair of stones expressly for grinding middlings, of three or three and a half feet in diameter, of a rather close texture, having one inch to the foot draft, with ten or eleven quarters,

and three furrows to each quarter; these furrows one and a fourth inches broad, and one fourth inch deep at the eye of the stones, tapering a little to the verge, the running stone being made deeper at the eye. This stone should not run more than one hundred and thirty revolutions per minute; when run too fast they will not feed. The eye of the stone should be five inches in diameter at top, and ten inches at the bottom or face of the stones. The wide part of the eye should be lined with zinc or tin from the face to a little above the balance ryne; if these instructions be followed, there is no danger of its choking.

Reels for Bolting the Middlings.

In many mills but one reel is used for bolting middlings; but it is much better to have two, as the wheat is often damp; therefore, the flour will be better sifted by its passing through a greater length of cloths. These reels should be fourteen or sixteen feet in length, with a half inch to the foot fall, having movable bridge-trees, to raise or lower at pleasure; the upper reel to be covered with No. 10 cloth the whole length; the head end of the lower reel for half the length to be covered with the same number of cloth, and the other half with No. 8 cloth; the speed should be thirty revolutions per minute. When only one

reel is used, the head may be of No. 10 cloth, and the tail of No. 8 cloth. The bolting-chest should be constructed having sufficient slides, so that the flour may be elevated into the hopper boy, and bolted with the meal, and made into superfine flour; or it may be packed separate as it is.

Instructions for a Small Mill, grinding different kinds of Grain.

In bringing this subject before the public, I conceive that my suggestions will be more readily understood by confining myself to a description of the manner of dressing, fitting up, etc., of a pair of mill-stones two feet in diameter, that size being the smallest I consider should be used for the purpose of grinding grain. Any party when selecting a small mill of this kind (ready fitted up) should choose one that is constructed in the simplest manner possible. If there is much machinery attached to it, it is apt to get out of order and want repairing, when the great difficulty is to find a miller or mechanic competent, in the country (where these mills are generally used), of repairing them; therefore, they have to be sent to the builder to be repaired, often costing as much as would purchase a new mill. Neither would I recommend a mill with a pressure on it; if pressed hard, the friction being great, and the

stones having a heavy feed, it will take more power to drive it than stones without the pressure twice as large; whereas, larger stones will do more and better work, and be more profitable. Small mills will run better and more true with a belt or strap, as it takes off the jerks of the moving power; neither should the running stone be too thick, as it will not run so well when top-heavy; the weight should be as near the face as possible. When selecting the stones for a small mill, choose them of a sharp, keen grit, full of small natural pores, rather close and closely jointed. The manner of dressing a two feet stone and making it ready for grinding, is somewhat similar to that described for large stones, viz: first, bring the faces of the stones to a level and straight state, by picking off the higher parts, rubbing with burr blocks, using your painted staff to guide and correct you as you proceed; and when straight lay out your furrows, viz: by fitting a board in the eye of the stone, and having found the centre with your compass—one point in that centre and set having one inch space—describe a circle round the centre on your board for the draft circle, and also another circle close to the verge of the stone. You then divide the latter into twelve equal parts or quarters, making a plain mark at each point; then, with a furrow-stick one inch wide and perfectly straight, lay off the leading furrows, one end of the stick being on the

outside of the draft circle, the other end at the point on the circle of the verge, marking the same with a quill having paint on it, on both sides of the furrow-stick; the remainder of the furrows are marked off in a similar way. You next mark out the short furrows—that is, one only between each leading furrow, and in the middle of each quarter, intersecting the leaders; this gives each stone twenty-four furrows. (The sands should be a little wider at the verge than at the eye, as they require more face.) Cut these furrows in, the backs of the furrows being cut straight, nearly one-fourth inch deep, tapering to the feather edge, which should be nearly even with the face of the stone; the feather edge is nearest to the centre of the stone. The furrows should be made deeper at the eye of the running stone, to enable it to receive the grain the more readily, and they should be dressed smooth and even; and the sands should be made a little hollow, about one inch from the eye of the running stone.

I consider it unnecessary for me again to mention the manner of fitting the irons in the stones, that subject having been already described in this work, and to which reference should be made, nor to mention the manner of dressing the stones when they become dull, that also being before described, observing only that small millstones require to be oftener taken up and dressed than larger ones, to enable them to do their work well. These mat-

ters, then, being attended to, and care shown that the faces of the stones are smooth and even, the furrows kept straightly marked with the furrow-stick and dressed to their proper depth, the bed-stone level, the spindle being exactly in its centre, and the stones truly in trim, and the running stone well balanced, there is nothing to prevent the stones from grinding well, making good meal, and not taking much power to run them.

I have thus endeavored to explain the manner of dressing, setting, etc., of the largest sized mill-stones in general use; also the smallest. I consider it unnecessary to describe those of an intermediate size, as they may be dressed in the same manner and by the same rules as laid down for the others. All I think that is required is to give the size of the draft circle, the speed, and the number of quarters in each size, viz: for a four feet stone, four inches draft, twelve to thirteen quarters, having three furrows to the quarter, and speed of one hundred and eighty (180) to one hundred and ninety (190) revolutions per minute. For a three feet stone, three inches draft, ten quarters, and three furrows to the quarter, and to run from two hundred and thirty (230) to two hundred and forty (240) revolutions per minute.

Corn meal can be sifted when grinding through a shaking sieve, viz: a frame made of wood, four or five feet long, one foot wide, and the middle filled with No. 14 wire; the crank to shake the

sieve being one and a half inches in diameter. It may be driven from the mill spindle by putting a pulley on the spindle, and one on the shaft of the crank, and run with a belt; the crank to run two hundred revolutions per minute. The shaker should lie on an incline, so that the bran will pass over the wire and fall at the end.

Buckwheat may be sifted the same way, by having the frame or sieve covered with No. 40 wire.

Of the manner of Packing Flour.

To the owners of mills, I would recommend the flour to be run from the bolts into the binn, to get cool and well mixed. Then each barrel of flour will be equally alike.

The best plan of barreling the flour is with an auger machine, as you can then grind all night and barrel all day, saving a great expense; and it is a more expeditious way of packing than any other. I cannot recommend the rolling (wooden) packers for this reason: the flour comes damp and warm from the bolts, and is very likely to sour if kept any length of time. When the flour is pressed hard in the barrels, it being damp, has no vent, and thus the flour sours. If the flour be warm without being damp, it will keep a long time. There will always be a difference in the quality of the flour, if packed when coming

directly from the bolts, caused by the stopping and starting of the mill, and also by the different changes of wheat that you grind.

If you have no augur machine, I would recommend it, anyhow, to be run in the binn; mix it well, and pack it in the barrels with a shovel, which will, as I said before, render it all of one quality.

My experience has proved that wheat or flour goes through a sweating process. If wheat be threshed out before stacking, and ground immediately, without going through this process, the flour, when ground and barreled, may be perfectly white; but on standing a short time will appear of a dark color, while the process of sweating is going on; it will afterward, however, return again to its original color.

Flour barrels should be made of the best seasoned timber, to prevent the hoops from becoming loose in shrinking, as well as the adhesion of the flour to the inside of the barrel.

The barrels are generally made nineteen inches in diameter, at both ends, and twenty-seven inches in length, bound with ten hoops. After the packing, additional hoops or linings are put inside the heads and nailed; it takes thirty-six nails. They are then ready for shipping.

Barrels, after being made, should be accurately weighed, and the weight marked thereon, so that the exact quantity of one hundred and ninety-six

pounds of flour can be put in afterward. The operation of packing being done often in a hurry, it is requisite the barrels should be tested occasionally; otherwise more than the proper weight of flour may be put in the barrel, thereby causing a great loss to the owner.

The branding of flour requires great care; for, if flour is poorly or badly branded, it very often injures its sale. This, although frequently done carelessly, without sufficient attention to its neatness, requires the miller's attention to see that the quality of the flour is equal to the brand it bears. This is an essential which every respectable mill should keep inviolate.

A barrel of flour should weigh one hundred and ninety-six pounds, exclusive of the barrel.

TABLE.

Showing the number of pounds which constitute a bushel, as established by law, in the States therein named.

ARTICLES.	MICHIGAN.	INDIANA....	ILLINOIS...	WISCONSIN	IOWA.....	MISSOURI..	NEW YORK
Wheat	60	60	60	60	60	60	60
Corn, shelled	56	56	56	56	56	56	56
Corn, on ear	70	68	70	70	70	70	70
Oats	32	32	32	32	33	35	32
Barley	48	48	48	48	46	48	48
Rye	56	56	56	56	56	56	56
Buckwheat	42	50	52	40	52	52	48
Broom Corn seed	46	46	46	46	46	46	46
White Beans	60	60	60	60	60	60	60
Castor Beans	46	46	46	46	46	46	46
Irish Potatoes	60	60	60	60	60	60	60
Sweet Potatoes	55	55	55	55	55	55	55
Turnips	55	55	55	55	55	55	55
Onions	57	57	57	57	57	57	57
Top Onions	28	28	28	28	20	28	28
Peas	60	60	60	60	60	60	60
Dried Peaches	28	33	33	28	33	33	32
Dried pared Peaches			40				
Dried Apples	28	25	24	28	24	24	22
Corn Meal		50	48	48	48		
Bran	20		20	20	20		
Malt	38	38	38	38	38		
Orchard Grass seed			14				
Hungarian Grass seed	48	48	48	48	48	48	48
Hemp seed	44	44	44	44	44	44	44
Flax seed	56	56	56	56	56	56	56
Sucrum			60				
Osage Orange			33				
Stone Coal		70	80				
Charcoal	22	22	22	22	22	22	22
Unslacked Lime	80	80	80	80	80	80	80
Coke			40				
Coarse Salt	50	50	50	50	50	50	56
Fine Salt			55				
Plastering Hair	8	8	8	8	8	8	8
Clover seed	60	60	60	60	60	60	60
Timothy seed			45	46	45		
Red Top seed	14	14	14	14	14	14	14
Millet seed			50				
Buel Grass seed	14	14	14	14	14	14	14

The Duty of the Miller.

We will suppose that the mill, in all its various departments, is completely finished and ready for grinding, and supplied with a stock of grain, flour barrels, nails, brushes, picks, shovels, scales, weights, etc., when the millers enter upon their duty (properly speaking); I have therefore thought it both right and proper, in a work of this kind, to add the following remarks, in order to show of what that duty consists.

In a large mill, where three millers are employed, there should be one head miller, to whom is entrusted the whole management of the mill, and who directs the other millers and work hands about the mill the work they have to do. The head miller should be at the mill early in the morning, and take charge of it during the day; see that every part of the mill is doing its work properly before he leaves at night, and that there is sufficient wheat cleaned to last throughout the night, as the other millers, when on watch during the night time, should have nothing else to attend to but the grinding and bolting. In the day time, however, it is best to take up one pair of stones daily and have them dressed. The head miller can test the face of the stones with the staff, and give instructions to the other millers in which way he wishes them dressed; while, in this manner,

each of the other millers dresses a stone in his watch. The night is divided into two watches, the first of which ends at one o'clock in the morning, and belongs to the second miller; the third miller then takes the watch, and continues on till one o'clock in the day.

When the mill has only two millers, one of these is called the head miller, being responsible for all the work done in the mill; therefore, he should have full management of it, and his instructions the second miller should observe attentively, and do the work accordingly. The head miller should, however, consult and be agreeable with his partner; thus they will work cheerfully and pleasantly together, each taking his watch, and having charge of the mill, time and time about.

The miller should not be entirely governed by the mill owner as to the time the stones should be dressed, the owner often wishing them to run a long time without dressing, thereby losing no time in the working, but very, very often losing a great deal otherwise by spoiling the flour. A miller should, therefore, stipulate to have it in his power to take up the stones and dress them whenever he thinks they want it.

The mill should be kept clean, as nothing looks much worse than a dirty mill.

To make the machinery run easy and smooth, the cogs should be well greased with a mixture of black lead and tallow every day, and the gudgeons

should be oiled once in each watch. A few drops of oil are better than pouring on a large quantity; when a few drops only are applied, they stop there and serve for the purpose, whereas a large quantity runs off, is wasted, and creates dirt and filth. When a large gudgeon takes to heating, it is often stopped by laying a piece of rusty bacon on the top. The cause of the gudgeons heating is from the friction of the parts rubbing together, and the velocity with which they move. If grease will not stop their heating, cause a small quantity of water to drop on the gudgeon, but not so much as to destroy the polish made by the grease.

If the owner of the mill is not a practical miller himself, yet he may form some idea of the capability of the miller from examining the quality of flour made; if it is white and free from specks, and the offal light and clean, he may feel satisfied that the mill is doing good work.

Pearl Barley, or Pot Barley.

Pot barley is barley of which the outer skin or husk has been removed; pearl barley is the small round kernel that remains after the skin and a considerable portion of the barley has been ground off. The mill consists of a common grindstone, four feet in diameter, thick, and perfectly sound, such as Cutlers use; or of stones that come from

Germany, of a darkish color, and which are used by a great many for this purpose. Where these German stones are used, they should be dressed with small ribs or sands on each side, and the same on the edge, which is not necessary for the common grindstone. A hole is cut in the centre a little larger than the shaft, to give room to hang it correctly. It should have two iron flanges, one on each side the stone, having four prongs each, with holes for bolts to fasten the stone, the prongs to be ten or twelve inches long each, to be let in the stone even with the face, and holes drilled through the stone for the bolts to go through the flanges and stone to make it fast, the flanges wedged tight to the shaft. It should revolve vertically on a horizontal shaft; the case revolves on the same axis in the same direction, but with a slower motion. The flat side of this case, as well as the rim or circumference, is made of perforated plates of sheet-iron. The barley is let in by a square opening in the circumference, when, the slide being shut, the machinery is set in motion until the barley is tossed between the stone and the case by the double motion, and has been entirely deprived of its skin, and is become pot barley; or till it is ground into the small round shape of pearl barley.

The mill is then stopped, the slide pulled, and the case turned so that the opening will be under-

neath, and the prepared barley falls into the bag or box placed to receive it.

It don't want much sifting, for such is the violence with which the grain has been tossed about, nearly all that is ground off is driven through the holes in the case, and collected in a closed chamber that surrounds the apparatus. The stone should revolve five or six hundred times per minute; the case to revolve once for every twenty times of the stone. The mechanism by which the stone and the case are moved is extremely simple. Hominy can be made from the same machine.

Pearl barley is very wholesome and nutritious, and has a very agreeable taste. It is generally used among soups; or, in case of sickness, it is a light, nutritious, and agreeable food.

The Art of Distillation.

The principle on which this art is founded, is evaporation and condensation. I will give some instructions for a small country distillery, given to me by a practical distiller, who has followed the business for a number of years.

First, there should be two stills and a doubler—the former holding one hundred and twenty gallons each, and the latter forty gallons. These

should be made of white pine plank, two inches thick, hooped with strong iron hoops, to be placed in such a position that the liquid can be run from the doubler, or uppermost still, into the next one below; and from that to the third or lowermost one; then to the hog trough. Also a worm made of copper, five or six coils two inches in diameter, placed in a tub, near the doubler, with plenty of cold water running in the tub to keep it cool; the worm to be connected with the doubler by having a small iron boiler, eighteen inches in diameter and six feet long, set in the ordinary way. Steam can be sent into the lowermost still, which will soon boil; the steam from this will boil the next; this, again, will boil the doubler, and from that the steam will pass into the worm, where it is condensed with the cold, and runs out whiskey. This distillery is calculated to run off at one time only one bushel of corn meal, and its quantity of malt will be when made into wort. The distiller can use as many tubs as he thinks necessary. The common way of mashing is to take a quantity of the spent wort from the still and put in the meal, at the same time stirring it well to keep it from running to lumps, adding the wort and the meal until the quantity of meal is well mixed and scalded; then sprinkle on the top, half a gallon of ground malt, and let it stand a few days; then fill up with cold water, at the same time stirring

the mash, and mixing it well; after which fermentation will soon begin (the heat ought to be between sixty and seventy degrees), which will last about four or five days, and then will be ready to run. The above is the common or sour mash. Some use the sweet mash, which is more speedy. It is made by using boiling water instead of the spirit wort, then filling up with cold water directly; and when at about sixty or seventy degrees of heat, add yeast sufficient to start the fermentation. This process requires fewer tubs than the other. When the tub is ready to run off, which will be easily understood by the distiller, it is put into the second still, and run until it will no longer carry a bead; then the steam is shut off, and the wort that was put into the second still is let off into the first, and the second still again filled with fresh wort, and as before, put a small quantity of water into the doubler. Now let the steam into the first still, and it will drive what alcohol there was left before into the second still, and from that to the doubler, which being connected with the worm, produces whiskey. The strength will be all gone from the first still, when the residue may be run into the hog trough. This process should be repeated until all the tubs are run off. After it is too low for proof whiskey, the balance can be run off, which is called low wines; and in commencing this, the low wines are put in the doubler instead of water

the second still being filled with wort, etc., as before.

The whiskey may be rectified by passing it through a tub whose bottom is perforated with small holes, and held up with blocks of wood two inches high, and covered with a blanket; then a layer of ground charcoal two inches deep; then cover again with a blanket and ground charcoal several times—the blankets and charcoal alternately. Pour your whiskey on the top of this, and let it filter through.

The coloring of whiskey is done with burnt sugar.

Of the importance of Draughting and Planning Mills.

I would recommend before building a mill, to have a correct plan drawn on paper, showing the size of the building, and the way in which every part of the machinery is to be placed.

The use of draughting mills to build by, is to convey our ideas more plainly than is possible by writing or speaking alone; these may be misconstrued or forgotten. But a well drawn draught speaks for itself, if once perfectly understood by the workman; who, by applying his dividers to the draught and to the scale, finds the length, breadth, or height of the whole building, or the

dimensions of any piece, and where it is to be placed.

By the draught the quantity of timber can be ascertained and made out. It should also show every wheel, shaft, and machine, and their places, thus finding whether the house is of sufficient size to contain all the works necessary to carry on the business. The builder, or owner, understanding the plan, proceeds without error, and can direct the mason and the carpenter where to put the doors, windows, and leave other openings, in the places where they are requisite; whereas, if there be no plan of the building, every thing goes on as it were, in the dark, much time is lost, and errors committed, entailing, in some cases, a heavy loss. Every master builder at least, should know the proper way to draw a plan, and give a true estimate of the cost, as well as working by it.

If the plan of the mill is correctly drawn the estimate of the whole cost can be ascertained; then may every species of the materials be contracted for to be delivered in due time; the work can then be carried on more regularly without disappointment, and when done is more complete, with a considerable sum of money saved.

The evils or disadvantages of building a mill without having a plan or draught to work by, are, that the machinery in the mill is badly constructed, the timbers are cut to waste, the machinery placed at different parts of the mill-house in various

positions, taking up more room than necessary, and extra wheels to drive. It frequently occurs that some parts have to be altered, or new ones put in, before the mill will do good work With these considerations, any reflecting mind can perceive that the most expensive mill is that which is built without a plan. My own impression is that the cost is nearly one-third more; besides, the mill in general is not so good.

It often seems that those who have but little experience in the milling business, frequently have the best and most complete mills. The reasons are, because the professional man is bigoted in his old opinions, relying from practice on his judgment and his own plans. It is better, therefore, to advise with good and practical mechanics, and get from them what they consider the best manner in which a mill should be built. They are seldom unwilling to impart this information, and there is no one but can glean something, even from a bad workman. A merchant who knows but little of the miller's art, or of the structure or mechanism of mills, yet is about to engage in milling, should naturally be led to take the following steps: he should, with experienced millers or millwrights, view the site of the mill, and get their opinion with respect to the proper and best place for the mill-house to stand. When they have decided on this, he shows them the plan or draught of the mill, inquiring if that will

suit such a site, or if there is any deficiency, and to point it out. If there be any alterations necessary the millwright can soon perceive it; and if he can give sufficient and substantial reason for their adoption, can make such as are requisite.

I would recommend millwrights, when building flour mills, carefully to select a practical and experienced miller to superintend the dressing and fitting up of millstones. If this—which I consider one of the principal parts of milling—is not properly done, the stones are certain to make bad work, and make the machinery run irregular. The miller will lay the whole blame on the millwright, giving him considerable trouble, besides injuring his character as a mechanic, and making unnecessary expense, with loss of time.

Cogs:—The Best Time for Seasoning and Cutting them.

The best time for cutting cogs is when the sap runs at its fullest. They should always be cut of a size larger than is necessary in use, to admit of their shrinking in the seasoning. If cut when the bark is set, they are apt to be worm-eaten, and in every case, if dried hastily, will crack. It is better to have them cut a long time before being used. If you have not any seasoned wood on hand you can dry your cogs in the fol-

lowing manner, viz: boil or steam them first; then put them in a kiln, covered so as to keep the smoke amongst them, in the same way that boards, scantling, and other timbers are dried; dig a hole in the side of a hill, about six feet deep and six feet wide, with a post in each corner, and plates on them, on which lay laths on edge, and put the coggs on these laths, setting them on end nearly perpendicular, and so that the smoke can pass freely through or amongst them; cover them slightly with boards, putting earth on the top of the boards; make a slow fire, and close up the sides to keep the smoke from escaping. Renew this fire once a day for ten or fifteen days, until they are perfectly dry. When taken out let them be kept in a dry place for some time before using; they will then be less liable to crack in working. If used before they are perfectly dry, they will be sure to shrink and become loose. The taking out of loose cogs and fitting in pieces with them again—as is often done—cannot be too highly censured. It altogether alters the pitch, and makes the machinery run badly, and the cogs themselves soon wear out.

The best kinds of timber that we find in this country for cogs, are hickory, maple, and sugar tree. Get some timber that is hard and tough, and has a fine grain. If the said timber is not well seasoned, I would always recommend the logs to be taken immediately to a saw-mill, and have

them cut into plank the thickness you want them, always keeping enough by you for any emergency, as they take but little room. If they are seasoning for seven or eight years they are so much the better; for when seasoned that length of time, if they are fitted properly in the wheel, they will last two sets of others that are not so well seasoned, and will run better, as they will not get loose in the mortice; besides, if you should want to dispose of them, you can get a great deal more than their first cost.

Above all things, it cannot be too highly impressed on the mill owner the necessity of having the most experienced workmen in laying off the dressing and fitting the cogs; the reverse bringing its own punishment in the quick wearing out of the cogs themselves, the disarrangement of other parts of the machinery, and consequently the inferior grinding of the flour.

When stepping off the cogs the millwright should be careful to have them divided evenly and alike; that is, the starting point when stept round with the compass should be exactly in the point you started from; if there is any variation they will never run true, as the cogs are formed from this point.

The Framing of Mill Work.

When the framing of the mill and parts that carry the machinery is not well bound and firm, a vibratory motion in its parts takes place, which expends a considerable portion of the power applied. (This loss of power is but seldom noticed.) I would observe that firm and well bound framing is preferable to heavy framing not so well connected in its parts.

Framing in any part of a mill should be done sufficiently strong, stiff, and heavy, to give it solidity and steadiness from the machinery and its motion, which occasions a tremor in all parts of the framing. The framing also requires to be constructed so as to be easy of repair, and so arranged that any particular part or piece can be renewed or repaired with the least possible derangement to the other parts of the framing. It demands great attention, as the shafts often require to be restored to their true situations, from which they have deviated by the sinking of the mill-house or wearing of the parts; therefore, the portions of the framing adjoining these parts should be so constructed that the shaft may be moved in any way, or made true without having any unnecessary obstruction. Although the framing which supports the mill-house and machinery should be made firm, yet the part on which the

axis rests should have a small degree of play, or elastic tremor, when the machinery is in motion, as it diminishes part of the friction. The framing, again, that supports the machinery, should be as independent as possible of the building, as communicating with the building is injurious.

It is acknowledged by practical mechanics, and has been tested, that a cast-iron shaft, of large dimensions, with a core or hollow in its centre, is stronger than one without it. This no doubt arises from the fact that the case affords a sensible spring, in case of a sudden strain, and is therefore less liable to fracture.

It is necessary when building a mill-house to have it at least four stories, or as high as the situation will admit, as then the machinery can be placed to the best advantage, and the expense of machinery will be reduced. It will also take up less room, and can be placed in its proper place so as to be easily altered if required, and giving room for grain, flour, &c., &c.

It is also necessary that the beams and joists should be made strong. For instance, a joist or beam sixteen feet in length should be made four times as strong as one eight feet in length, similarly situated, as the stress increases in the middle when it has its supports from the ends. It therefore follows that a beam should be strengthened in the middle in proportion to the strain of weight that is to be put upon it. There should be a

perpendicular post set under it sufficient for such weight.

The husk-frame for the mill-stones to lie on is one of the most particular parts, and requires the best of mechanics to set the work properly. If this is not correctly done, there certainly will be vibration in it, which will disarrange the rest of the machinery, and cause the whole to run badly, besides taking considerably more power.

The top of the husk-frame should project at least eighteen inches above the floor, as it will be better for putting in the spouts from the stones, besides giving the miller a better chance of feeling the meal and setting the stones.

I would recommend the husk-frame to be made of cast-iron, as they are preferable to those constructed of timber, on account of being more durable, and not so likely to vibrate.

These qualities will fully compensate for the additional expense over those made of timber.

Wind Mills.

Wind mills are so seldom used in this country, I think it unnecessary to give more than a few hints respecting them. Were it not for the irregularity in direction and force of the wind, it would be the most convenient of all the first movers of

machinery. But even as it is, its efficacy may be taken advantage of in some cases.

There are so many various kinds of wind mills constructed, that if all were treated upon in their proper manner, it would take up too much time and space in this work. I therefore think it only necessary to make a few remarks respecting the common vertical wind mill. But I must say, in the first place, that they are not profitable in this country, where other power is to be obtained, for the reason that the wind being so irregular the mill is sometimes even in danger of being blown down, or the sails carried away; at other times again there is not sufficient wind for weeks to drive the mill.

Wind mills are so constructed that the sails will move nearly vertical. These sails communicate motion to the wind-shaft and the break-wheel; also to the centre wheel that conveys the same motion along the upright shaft to the spur-wheel—a pinion or trundle which propels the stones. The sails require to be made so that the wind will have the greatest possible effect on them. The wind does not act perpendicularly on the sails of a wind mill, but at a certain angle, as the sail varies in its degree of inclination at different distances from the centre of motion, in resemblance to the wing of a bird; this is called *weathering of the sail.* The proper angle of a sail is as follows, the radius being divided into six equal

parts, the first part from the centre being called one, the last six—thus:

Distance from the centre.	Angle with the axis.	Angle with the plane of motion.
1	72° 00′	18° 00′
2	71° 00′	19° 00′
3	72° 00′	18° 00′
4	74° 00′	16° 00′
5	77° 30′	12° 30′
6	83° 00′	7° 00′

The velocity of the wind mill sails, whether loaded or unloaded, so as to produce a maximum, is nearly as the velocity of the wind, their shape and motion being the same. The length of the whip or sail is measured from the centre of the great shaft to the undermost bars. The backs for straightening and carrying the sails should be made of the best of timber, to be free from knots. These are mostly made of pine or oak. The sail is fastened to this back with strong iron screw-bolts. If the sails are thirty feet each in length, the backs should then be forty feet in length, or two thirds of the sails. The back is made as thick and wide at the middle as will fit the mortice in the wind shaft, and tapering gradually from the middle to the ends of the wind shaft. It requires a practical mechanic to give it the proper bearing on the neck and journal. If this is not done, and the shaft given its proper incline, it will

take more power. The proper inclination they should have must be left to the workman, as it varies in different sites from the weight of the wheel and sails, the length of shaft, &c. The general rule is to give them from one to two inches to the foot of fall.

The head of the shaft should be set a little to the windward, as the cloths will then keep close to the sails without flapping about. If the wind-shaft is made of wood, the neck should be turned even and true; and a sufficient number of ribs, which are made of steel, let in the neck even with it, and of the same circle; if this is not correct, there will be a loss of power.

The weight of the wind or sail shaft is borne on a strong timber, having a brass box placed in it to receive its weight. This is fixed stationary, so that it will not move when running. This brass box should reach one third round the circumference of the neck. The other end of the shaft gudgeon runs in a brass box. The break for stopping the mill is hung round the large uppermost wheel, and should be placed so that the wheel will be free from rubbing against it when running. One end is fixed stationary; the other end is made fast to a lever, with a rope and pulleys attached to it, so as to raise the break when running, or lower it so that it will rub on the break of the wheel to stop it. The wind shaft of a wind mill, when the wind's velocity is two

miles an hour, will make three revolutions per minute.

Supposing the radius of the sails to be thirty feet, the sails will commence at one sixth or five feet from the axis, where the angle of inclination will be seventy-two degrees at one third or ten feet from the axis, the angles will be seventy-one degrees, and so on as in the table.

A wind mill with four sails, measuring seventy-two feet from the extremity of one sail to that of the opposite one, and six feet seven inches wide, is capable of raising one thousand pounds avoirdupois two hundred and thirty feet in a minute. When a wind mill is grinding grain, the millstones should make five revolutions in the same time that the sails make one. The sails will not begin to turn till the velocity of the wind is about twelve feet per second.

A Table of the Velocity of Wind.

Character.	Feet per second.	Pressure per square foot in pounds.
Scarcely sensible,	1.5	.005
Gentle wind,	3	.123
Moderate breeze,	6	.133
Brisk breeze,	18	1.21
Good breeze,	22	2.85
Brisk gale,	30	4.42
High wind,	45	9.96
Very high wind,	60	17.71
Storm,	70–90	30.49
Hurricane,	100 or more	

The velocity of the wind in a gale is often as high as forty or sixty miles per hour, with a pressure on the sails equal to fourteen or twenty pounds per foot. It is necessary there should be a governor attached to every wind mill, to regulate the speed of the mill-stones. A description of the governor, which is the same as recommended for steam and water mills, will be found in a subsequent part of this work. It is placed in a position a short distance from the mill spindle, and driven with a strap and pulleys from the mill spindle. A rod of iron runs through the end of the bridge-tree, which hangs on the steel-yard beam, so that when the governor balls rise or fall, they raise or lower the running stone. It is necessary to have them work correctly, so that when the stones are set correctly to do their work, they will not vary in their grinding as the wind varies. The feeding shoe requires to be made lengthy, and the damsel made to strike the shoe properly, so that the feed may be regulated as the speed varies.

In building a wind mill, I would recommmend those having the self-acting sails. These sails are made nearly similar to the others, except the canvas covering, which is of small boards, and somewhat similar to window blinds. The wind, therefore, regulates them by acting on a governor, which regulates the sails as the wind varies, by opening or shutting the blinds or wind-boards, as these

boards are made so that when there is too much wind they will open and let it pass through them; or, if there is not so much wind, they will shut so that none can pass through.

There should be machinery attached for turning the cap or roof round, so that the sails will always be at right angles to the wind. On the spindle a director is placed—an endless screw, working in a wheel which turns a shaft having a pinion fixed at the other end of it. This pinion works into the segment wheel, or cogs, round the segment. The director is a small wheel, placed behind the mill, so that the wind acts on it to keep the sails properly in the wind. It is necessary for the mill-stones to be of a large diameter in a wind mill, in consequence of the wind being irregular, as they will grind a larger quantity of grain; besides, when the wind is blowing hard, the mill is more easily stopped by lowering the stone and giving it more feed. The best sized mill-stone that I would recommend is five feet.

The wind mill is used to advantage on the bank of a large lake, or near the sea, the wind being more certain. In most parts of Europe, it is one of the principal mills for manufacturing flour; and I believe on large prairies they would answer a good purpose if properly built.

Instructions for Baking.

This branch, though not properly belonging to the milling business, is often connected with it, and when the mill is in a suitable place, is profitable in the highest degree to the mill owner—consuming his own flour, saving the expense of shipping, commission, etc., thereby taking less capital. These considerations have induced me to offer these few remarks on the subject, in the hope that it may prove beneficial.

In the first place, I shall give the receipt for making yeast, as used by most bakers in this country, and called hop yeast. Boil five gallons of water and ten ounces of hops together from ten to fifteen minutes; put six pounds of flour in a tub, to which add as much of the boiling liquor as will be necessary to make into a thick paste. When the remainder of the liquor is perfectly cool, add it, together with a gallon of stock yeast, to the paste, when the whole will be ready for use.

Secondly: A receipt for making another kind of yeast, sometimes used, and called malt yeast: Boil ten ounces of hops in five gallons of water, from ten to fifteen minutes; pour the same into a tub. When cooled to seventy degrees, Fahrenheit thermometer, add a half peck of malt; stir the whole up well, and cover it until nearly cool;

when add three quarts of old yeast, to make it ferment.

And thirdly: The quantities and best manner of mixing the different ingredients necessary to make good bread, viz: to make the fermentation, say for ten buckets of flour, take five gallons of potatoes well boiled and mashed in a tub, with one bucket of water, (in summer this water should be about milk warm—in winter, much warmer—in all cases this must be governed by the weather,) six pounds of flour and five quarts of yeast; stir the whole up well, and cover it up until it rises. It is better to work the same as soon as it does rise and commences falling again; otherwise, the bread will not be so good. The time of rising, however, varies much; sometimes it will rise in eight hours, at other times it will take much longer. Again, to make the sponge: Take two and one half buckets of the above ferment, and two and one half buckets of water, milk warm, run the whole through a sieve into a trough, and make it into light dough, with flour for sponge. When this sponge has risen and commenced falling, add five pounds of salt and five buckets of water; break the sponge well in the water, and stir up sufficient flour to make a stiff dough, cover it up until it rises sufficiently; it is then fit for being weighed off and put into the tins for baking. Let it stand in the tins until it rises, when it should be placed in the oven.

Receipt for making Babbitt Metal, etc.

Take eight pounds of block tin, two pounds of antimony, one pound of copper; (a larger or smaller quantity can be used; taking care, however, to use the same proportions of each, as here given;) these to be melted and mixed together over a hot fire. If the metal be too hard it may be softened by adding some lead. I have no doubt but this metal can be bought for less than you can make it; but you seldom can get any to purchase but what is of an inferior quality; in fact I would not recommend it. If made according to the receipt given above, I can recommend it as one of the best alloys that can be used for machinery running fast, it being of an oily nature, and not likely to heat, the friction being less than with any other alloy or metal. Journals will run on it, making two thousand revolutions per minute without heating. When making it, it is better to make a quantity that will last some time; for as it is wanted it can be melted over again.

Cement.

Cement for joining flanges of iron, cylinders or pipes, to withstand the action of boiling water or steam. Great inconvenience is felt by the workmen for want of a durable cement. The following I think will answer: boiled linseed oil, litharge,

and white lead, mixed up to a proper consistence, and applied to each side of a piece of flannel, linen, or pasteboard, and then placed between the pieces before they are brought home or jointed.

Cement for the joints of a steam engine is made as follows: take of sal ammoniac, two ounces; sublimated sulphur, one ounce, and cast-iron filings or turnings, one pound; mix them in a mortar, and keep the powder dry. When it is to be used, mix it with twenty times its quantity of clean iron filings or turnings, and grind the whole well in a mortar; then wet it with water until it becomes of a convenient consistence, when it is to be applied to the joint. After a short time it becomes as hard and strong as any other part of the metal. Another way is with a mixture of white paint with red lead spread on canvass or woolen cloth, and placed between the joints; this is best where the joints have often to be separateed.

Solders.

For soldering lead pipes, etc., melt one part of block tin, according to the quantity wanted; and when in a state of fusion add two parts of lead. If a small quantity of this when melted, is poured out upon the table, there will if it be good, arise little bright stars upon it. Rosin should be used with this solder.

To make solder for tin, take four parts of

pewter, one of tin, one of bismuth, melt them together, and run them into thin slips. Rosin is used with this when soldering.

For soldering iron: some good tough brass, with a little borax cement for stopping up holes in wood; melt in a pan one pound of rosin; when melted, add one fourth of a pound of pitch, and two ounces of shellac; while these are boiling, add brick dust, until by dropping a little on a cold stone, you think it hard enough. In winter it is sometimes necessary to add a little tallow.

To stop up the joints or large holes in the mill-stones: this is done with alum, melted, mixing burr sand with it. If the hole is large, put some pieces of burr mill-stones in it first, and pour in melted alum. I would recommend if there are any large holes or soft rotten places in the mill-stone, to cut them out and fix or fit pieces of burr blocks in to correspond with the temper and quality of the stone. These pieces of block should be cut exactly to fit, that there may be small joints, and fastened with plaster of Paris. These holes should be cut at least four inches deep; there is then no danger of them getting loose. It often occurs that the blocks put in a mill-stone are uneven—some being hard, others soft. When this is the case they are difficult to keep in the face. When there are one or two uneven blocks in a mill-stone, I would recommend that they should be taken out, and other blocks put in their

places, of the same texture as the remainder of the stones. This is easy to accomplish, and the stones made even and to work well. Mill-stones are often condemned as worthless, when *one block removed* would remedy the difficulty.

TABLE.

Showing the product of a bushel of wheat of different weights and qualities, as ascertained from experiments in grinding parcels.

Weight per bushel.	Superfine flour.	Tail flour & middlings.	Ship stuff.	Shorts and bran.	Screenings and loss in grinding.	Proof.	Quality of the grain.
LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	LBS.	
61	43	5	3	6	4	61	White wheat, clean.
60	42	5	3	6	4	60	Do. do. do.
60	39	4	3	7	7	60	Red wheat, not well cleaned.
55	38	4	3	6	4	55	White wheat, very clean.
53	35	4	3	7	4	53	Red wheat, well cleaned.
57	35	4	3	7	8	57	Do. with some cockles and light grains.
51	31	3	4	7	6	51	Do. very clean.

I have given in the foregoing table the quantity of extra superfine flour that can be made out of a bushel of wheat. In grinding wheat for exportation, the custom is to take as much flour out of it as possible, provided it passes inspection; in this case there is more flour made out of the bushel than laid down in the table, the flour not being so good. If, however, a complete separation of the skin of the wheat from the flour could be effected, and the flour be reduced to a sufficient degree of fineness, you may allow two pounds of

flour more to the bushel than is laid down in the table. When the wheat that is to be ground is damp and soft, it is impossible to make as much flour out of the same quantity as you could out of dry wheat; the bran will be thicker, as the flour will adhere to it. The flour will appear whiter, but will not keep so long, nor make as good bread; and when kept long will sour in the barrel, and often will have small worms in it. To make a barrel of extra superfine flour, it requires nearly five bushels of good wheat, without putting in the middlings. It may be made out of a little less when the stones are in a true and even face; and often (as I before remarked), when for exportation, is made from four and one half bushels, and sometimes from less. There is, however, a great difference in wheat; the skin of some is thick and hard—others soft and thin; this will show when separated from the flour. We are certain that the bran will not make good flour; therefore, when wheat is thin skinned, it will produce the most flour. Often the inside of wheat will be of a dark color, which will not yield as white flour; therefore, great care is required in the purchasing of wheat, if good flour is wanted.

In my experience millers will run on extremes in grinding different grades of flour; some setting the mill-stones too high, others too close; the middle way between the two I would prefer. When ground too close for making a yield, as it

is termed, the yield will be deficient; the flour being heated and sticking to the offal, so that the machinery will not cleanse it, besides making more middlings—they being of a soft, greasy nature, and will not feed, choking up the eye of the stone, and giving the miller extra trouble. When ground too high it bolts too free, making the flour too specky. I know it is very difficult to persuade most millers to alter their mode of grinding, in the way they have been accustomed to; still, I think, a few plain hints to a great many will not be amiss.

I would recommend when grinding wheat for private families to grind it a little higher than for shipping or for the baker; as the greatest complaint I always found with private families was, its not rising when made into bread. We all know the baker works the flour into bread quite different from private families.

By his process he can make almost any flour rise when manufactured into bread.

The different varieties of wheat require to be considered in the profits of millers, as the yield of flour of each is as the different samples. That sample of wheat which weighs heaviest does not always make the most flour, as is also sometimes the case with the first crop raised on new ground, of which when ground the offal will be thick and heavier than that raised on old ground. My experience of most of the wheat called Mediter-

ranean is that it weighs as much as most samples. I believe, however, that most of it is not profitable for the miller to purchase, for the reason the quantity or quality cannot be made. It is of a coarse, hard nature, difficult to grind; it always bolts too free; the flour becomes too specky; besides, the inside of the wheat is of a dark color, and making an extra brand of flour is almost impossible. I have seen some good Mediterranean, but they are few, and would not recommend any for making a choice brand of flour

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Of Saw Mills and their Management.

These being often attached to the grist and flouring mill, it is requisite some mention should be made of them. Not having much experience in this branch of business myself, I have consulted with several practical millwrights and sawyers, and the information I have gained from them, I here subjoin for the benefit of others.

Supposing the mill built and ready for work before the sawyers enter upon their duties. The mill should be supplied with all the necessary tools to work with, namely: a cart hook, for rolling on the logs; two iron cross bars, to move the log on the carraige; two axes; a saw set; two small dogs, to hold the plank in its place while sawing; one dozen of sixteen inch saw files, and a chest of tools to repair the mill when

required. The sawyer, before starting the mill, should prove every part, to see that it is set true and in its proper place. First prove and make the fender-post plumb every way; the fender-post is where the saw gate works in. It is better to have iron slides on the fender-post; these to be about three or four feet in length, and to be fastened on the fender-post for the jaws of the gate to work in, and set true and even; the jaws to work even on the slides, and screwed sufficiently fast to keep the gate or saw steady. The head-block, on which the log is to lie, on level, put the saw in the middle of the gate, measuring from the outside; set it by the gate, and not with the plumb-line, with the teeth at the top of saw projecting three quarters of an inch farther forward than at the bottom, as this will give the saw liberty to rise without cutting, the log-room to push forward as it rises. The saw is fastened in the gate by two irons in the form of staples, the uppermost one having nuts and screws on the top of the gate. The saw is stretched tightly by these screws, which should be nearer the teeth than the back of the saw, that it may be stiffest there. To prove that the saw is hung true, run the carriage forward, so that the saw will strike the head block; stick up a nail there, run it back its full length, stand behind the saw, set it exact to the mark again, set it in motion, hold a tool close to one side of it, and observe whether it touches equally the whole length

of the stroke; if not, it should be altered, or the lumber will not be square cut.

The length of the saw that is generally used is seven and a half feet and seven inches wide, when new. There are, however, other various sizes made, but I would not recommend one less than seven and a half feet, for the reason that it will cut a larger quantity of timber and larger logs. The sharpening or setting of the saw is done as follows: The teeth should be kept straight, and not suffered so wear hollow; this is done with a true, straight edge. When the points of the teeth are made straight, they should be cut of equal size and depth; to do which, lay the straight edge on the blade of the saw, and make a plain mark on the blade with a cold chisel, even with the straight edge, the whole length of the saw, and cut out each tooth to be of the same size and length (they should be from one and a half to two inches long, to enable them to clear themselves in the log); this is done with a sharp, cold chisel, the saw lying on a blacksmith's anvil. Then set the teeth a little wider than the blade, to prevent it binding in the log; commence with the uppermost tooth, and with the set bind it a little to one side, missing every alternate tooth, the length of the saw; these are to be set to the same side. You then set the remaining missed teeth to the opposite side, the same distance as the first.

They next want to be filed even and sharp.

In doing this, the wider part of the teeth should be made to slope up a little, the teeth made sharp; the outer corners of each tooth should be a little the longest. It is a bad practice to file the under side of the teeth level or drooping down; when this is done, the saw never runs so steadily, and is apt to wood too much. The crank, to do good work, should be fourteen inches from the centre of the neck to the centre of the rest or handle, which is five inches long to the key-hole, and two and a half or two inches thick; this should run, when the mill is at full speed, one hundred and thirty revolutions per minute. The mill should be so that it will stop its sawing when within three inches of being through the log; and arranged by the machinery to draw the carriage with the log back, that it may be ready for the saw again without losing time. One word of caution is, not to make the pitman too tight on the crank; in fact, no part of the mill that is moving should be tightened too much; just sufficient that it will not change its position when running, and work easy.

NOTE.—As the muley saw is used to some extent, when fast sawing is required, it requires a good sawyer to manage it, as there is more danger of bending or breaking the saw, on account of its speed, if not properly managed. This saw can be run much faster, as the gate is dispensed with, and is run generally at a speed of two hundred and upwards per minute.

The Circular Saw.

These require a sawyer who has some experience, to manage them, otherwise they will not be profitable. I find it difficult to lay down any one principle for his guidance. They mostly run vertically, having various kinds of wood to saw; their sizes being different, they all should be run with straps or belts; the speed, also, varies from two hundred and fifty to fifteen hundred revolutions per minute; this depends upon the diameter of the saw, and the thickness of the timber it has to cut. They cannot be recommended for sawing large logs or hard timber, as the saw often breaks, or becomes heated and is spoiled.

The shaft the saw is hung on should have one fourth inch play at the end, and be levelled true; the saw made fast and perpendicular; in fact, every part should be fitted to work easy. The sharpening of the saw is done nearly as the others; the teeth are kept their proper length and depth by running the saw backward, and holding a piece of grind-stone near them; or by describing a circle from the centre to the point of the teeth, and filing off the points; then describe one more circle the depth you want the teeth, and file them their proper depth. Set every alternate tooth a little on one side, and the remaining teeth to the opposite side. The saw, when running at a great speed and

cutting hard timber, should have water poured on it to keep it from heating. If suffered to run long, after it gets hot, the temper will be taken out of it, and render it useless.

It necessarily occurs that every journal, and where there is any friction, should have oil applied, to keep it from heating; it will also require less power and do better work.

Rules for Calculating the Speed the Stones and other pieces or parts of the Machinery run at.

The fundamental principles on which are founded all rules for calculating the motion produced by a combination of wheels, and for calculating the number of cogs to be put in them to produce the motion that is required, is to commence with the first moving power, which is either an engine or water-wheel. If, therefore, the revolutions the first moving wheel makes in a minute be multiplied by the number of cogs in all the driving wheels successively, and the product noted, and the revolutions of the last leading wheel be multiplied by the number of cogs in all the leading wheels successively, and the product noted, these products will be equal in all possible cases. From these we can calculate the number of revolutions any part of the machinery makes in

a minute. My intentions are to lay down simple rules, so that the millers of limited education may calculate the speed of any part of the machinery of the mill.

Rule First.

To find the motion of the mill-stone, the revolutions of the engine or water-wheel (we will call the first moving power), and the cogs in the wheel being given.

Multiply the revolutions of the engine or water-wheel per minute, by the number of cogs in all the driving-wheels successively, and note down the product. Then multiply the number of cogs or rounds in all the leading wheels successively, and note the product; then divide the first product by the last, and the quotient is the number of revolutions of the stone per minute.

Example.

Giving the number of revolutions of the first moving power, viz.: the engine or water-wheel per minute. 48

No. of cogs in the master cog-wheel, 56

288
240
2688

Amount brought over,	2688
No. cogs in spur or counter cog-wheel	99
	24192
	24192
	266112

Multiply the leading wheels, viz.: the number of cogs in the first leading wheel (48) by the number of cogs in the next, the pinion (32).

48
32
96
144
1536

Divide the first quotient (266112) by the last (1536).

1536)266112(173
1536
11251
10752
4992
4608
384

Thus the stones make 173 revolutions per minute.

Rule Second.

To find the speed the bolts run at, you first calculate the number of revolutions the upright shaft

makes per minute; it is made from the first mover (engine or water-wheel); it runs, per minute, 48

No. of cogs in the master cog-wheel, 56

288

240

No. of cogs in first leading wheel, 48)2688(56

240

288

288

00

The upright shaft runs, therefore, 56 revolutions per minute. Then multiply the number of cogs in the driving-wheel on the shaft, which is 40, by that of the upright shaft, 56, the quotient is 2240; which, divided by the number of cogs in the leader, 72, gives the number of revolutions the bolts make per minute, 31.

Another Example.

Given the first mover (the engine or water-wheel); its revolutions per minute are . 35

No. of cogs in master-wheel . . . . . 66=2310

Divided by the number of cogs that is in the wheel that is in the upright shaft, a leader, 37, gives the revolutions of the upright shaft 62 per minute. This, again multiplied by the number of

cogs in the spur-wheel, 95, gives 5890; which, divided by the number of cogs in leader or pinion, 36, gives the number of revolutions of the stone per minute 163.

The upright shaft runs, per minute, 62 revolutions; number of cogs that is in the wheel on the upright shaft, 37; multiplied, gives 2294, and divided by 74, the number of cogs in the wheel that drives the bolt, a leader, gives 31, the number of revolutions the bolts make per minute.

NOTE.—If any of the wheels be for straps or drums and pulleys, or are moved thereby, take the diameter of each drum, etc., in inches and parts, and multiply and divide the same as with cogs.

RULE THIRD.

To find the speed the smut mills make per minute.

First, the upright shaft runs, per minute, 56
No. of cogs in the driving-wheel, 73

168
392
4088

Which, divided by the number of cogs in the leader, 35, gives the number of revolutions the shaft makes per minute, which is 116

The smut mill is driven by a belt; take, therefore, the diameter of the drum or pulley, in inches, a driver. 72
232
812

Divide this quotient by the diameter of the leading pulley, which is 14 inches, and it gives the number of revolutions of the smut mill, 596 per minute. } 8352

Another Example.

The upright shaft moves, per minute, 62, × the number of cogs in the wheel on the upright shaft, 37 (both drivers), the quotient is 2294; which, divided by the number of cogs in the wheel that is on the lying shaft (a leader), 35, gives the number of revolutions of the lying shaft; it runs 65 per minute; this number, multiplied by 47, the number of cogs in the wheel of the lying shaft, gives the quotient, 3055, which, divided by 27, the number of cogs on the wheel in the upright shaft, gives the number of revolutions of the upright shaft that drives the smut mill, 113; which, multiplied by the diameter of the drum on the upright shaft, 48, gives a quotient of 5424; this, divided by the diameter of the drum (or leader), which is 18 inches, gives the revolutions of the smut mill, per minute, 301.

It is not necessary to mention any other parts of the machinery, as the calculations can be made from the examples given. There is no regular criterion as to size of wheels, number of cogs, &c., to suit in all situations. I consider I have given

sufficient to enable the miller to make his own calculations to suit circumstances, and to judge when any deficiency exists in the machinery, and correct it accordingly.

Very often, in building a new mill, the millwright will miss his calculations on the first moves, the engine or water-wheel not running the speed it was calculated for. If this should ever be the case, and the machinery not run its proper speed, then the miller can find out where the deficiency is, and make the alterations required.

To find the Quantity, in Bushels, a Hopper will Contain.

Rule.—Multiply the length at the top by the breadth, and that product by one third the depth; measuring to the point, divide the last product by the contents of a bushel in inches, and the quotient will be the same answer required.

Table of Dry Measure.

33.6	solid inches	in one	pint.
268.8	"	"	gallon.
537.6	"	"	peck.
2150.4	"	"	bushel.

Example.—How many bushels in a hopper

forty-two inches square at the top and twenty-four inches deep.

According to rule $42 \times 42 \times 8 \div 2150.4$.

Thus: 42 and 42 = 84; 84 and 168 = 1764.

1764 and 8 = 14112.

2150.4)14112.0(6.56

129024

1209.6 = 56/100

And we have for an answer 6.56 bushels.

Spouts—The necessity of making them large.

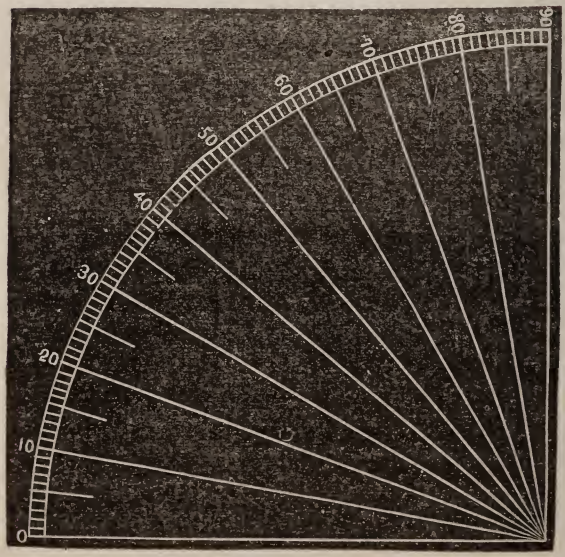
I think it necessary to notice this matter in this work, as I have often experienced a great deal of trouble in different mills from the spouts being made too small and confined. I believe many other millers can make the like assertion. Spouts should invariably be made of sufficient size that they will not be stopped with pieces of straw or other small substances, and should have sufficient slant that there will be no difficulty in their running.

Often the spouts are put in contracted parts of the mill; whenever this is the case, there should be a slide put in at the top, sufficiently large to put the hand in, or left open at the top, so that if they stop running they may be altered. When the spouts are contracted, or you cannot get slant enough, then it is best to use a tin one, as flour or meal will run much better than on wood. The

spouts from the mill-stones particularly should be as large as can conveniently be put in, to give air round the stone, as it will help to keep them cool. I believe if the meal could be run into the conveyor, or elevator, that the stones would require less power to drive them, if there were three large spouts to each pair of stones, as the stones, having to drive the meal round the hoop before it can leave the spout, are apt to both heat the meal and take more power.

To lay off any required Angle.

ONE FOURTH OF A CIRCLE.



Base line.

By this angle any degree may be taken near enough for any angle mentioned in this work, by applying the side of a bevel to the base line, and setting the blade to any angle required. I have thought it necessary, for the benefit of others, to give this cut of angles, as I have mentioned in this work of the angles of different degrees. I have made inquiry, and find by most mechanics that they work by guessing, without knowing whether they are right or wrong. As every one may understand it, I give above examples from ten to ninety degrees. It is generally known by mechanics that an angle of forty-five degrees is a mitre.

I know there are some mechanics that have a case of instruments. To such this will not be of any great benefit; but generally the workmen are without them. To such I hope this will prove beneficial.

Of Masonry.

Masonry is the preparing and combining of stones so as to properly touch, indent, or lie on each other, and become masses of walling and arching for the purpose of building. In stone walling, the bedding joints ought each to be laid horizontally when the top of the wall is to terminate so. In building bridges and fence walls upon inclined surfaces, the bedding joints ought to

follow the general direction of the work. A wall which consists of unhewn stone is called a rubble wall, whether mortar is used or not. This species of work is of two kinds, coursed and uncoursed. In the former, the stones are gauged or dressed by the chisel or hammer, and the masonry laid in horizontal courses, but not always confined to the same thickness. The uncoursed is formed by laying the stones as they come to hand, without any previous gauging, dressing, or assorting. Walls, columns, blocks of stone or marble, &c., are measured by the cubic foot; and pavements, slabs, chimney-pieces, &., are measured by the superficial or square foot. Cubic or solid measure is used for the materials and square, or superficial measure for the workmanship. In the solid measure, the true length, breadth, and thickness are taken and multiplied continually together. In the square measure, there must be taken the length and breadth of every part of the projection which is seen.

Of Artificer's Work.

Artificers compute the contents of their work by several different measures, namely:

1. Glazier's and mason's work is by the foot.
2. Painting, plastering, paving, &c., by the yard.
3. Partitioning, flooring, roofing, &., by the foot.
4. Brickwork, by the 1,000 or cubic foot.

Bricklayer's Work.

Brickwork is estimated at the rate of a brick and a half thick, so that if a wall be more or less than this standard thickness, it must be reduced to it as follows.

Rule.—Multiply the superficial contents of the wall by the number of half bricks in the thickness, and one half of the product will be the contents required.

Bricks and Laths—Dimensions.

15	common	bricks	to a	cubic ft. of	9	in. wall, laid.
22½	"	"	"	12	"	"
30	"	"	"	16	"	"
37½	"	"	"	20	"	"

Laths are from one to one and a half inches wide by four feet long, and are usually set half an inch apart, and a bundle should contain one hundred.

Example.—How many bricks will it require to build a house 30 feet square, 20 feet high, and 12 inches thick, above which is a triangular gable rising 12 feet and 9 inches thick.

Thus: $30 \times 6 + 30 \times 6 \times 15$ and $30 + 30 + 28 + 28 \times 20 \times 22\frac{1}{2}$.

360
15 bricks to 9 inch thick.
1800

30 × 6 is 180
30 × 6 is 180
360 and 5400 bricks in the gable ends.

30
30
28
28
116 and 2320

116
20 high.
2320

Then 2320
$22\frac{1}{2}$ bricks in a 12 inch wall.
4640
4640
1160
52200 bricks added to 5400 bricks = 57600 the answer.

5400
52200

Example 2.—How many bricks are required to build a mill house 60 feet long, 40 feet wide, 40 feet high, and 12 inches thick.

Thus $60 + 60 + 40 + 40 \times 40 \times 22\frac{1}{2}$ = the answer.

60 120 160 200
120 160 200 8000 and 8000

$22\frac{1}{2}$
16000
16000
4000
180000 answer.

Timber Measure.

Timber is chiefly estimated by the square or superficial foot of 144 inches, or cubic foot of 1728 inches, the calculation of which is performed by

duodecimals; that is, the foot and inch is divided into twelve parts or divisions, thus:

12 fourths	make	1 third.
12 thirds	"	1 second.
12 seconds	"	1 inch.
12 inches	"	1 foot.

And the several values are

Feet, multiplied by feet, gives feet.
Feet, multiplied by inches, gives inches.
Feet, multiplied by seconds, gives seconds.
Inches, multiplied by inches, gives seconds.
Inches, multiplied by seconds, gives thirds.
Seconds, multiplied by seconds, gives fourths.
And so forth.

Rule 1.—Place the multiplier under the multiplicand, feet under feet, inches under inches, seconds under seconds, and so forth.

Rule 2.—Multiply each denomination of the length, by the feet of the breadth, beginning at the lowest, and place each product under that denomination of the multiplicand from which it arises, always carrying one for every twelve.

Rule 3.—Multiply by the inches, and set each product one place toward the right hand.

Rule 4.—Then multiply by the seconds, and set each other product one place further to the right.

Thus prove in like manner with all the other denominations, and the sum will be the content.

Example 1.—Require the superficial contents of

a board 12 feet 6 inches long and 1 foot 5½ wide.

	F.	I.	S.	
According to rule,	12	6		
multiplied by	1	5	6	
	12	6		and we have for the
	5	2	6	answer, 18 feet, 2
		6	3	inches, and 9 sec.
	18	2	9	

The solid content of timber is found by multiplying the length of the tree or log by the square of the ¼ girth.

Example.—Require the contents of a tree in cubic feet, whose girth in the middle is 84 inches, and length 25 feet 6 inches. Thus, ¼ of girth 84 is 21, which is equal to 1 foot 9 inches, which is to be squared thus.

F.	I.	
1	9	
1	9	
1	9	
1	3	9
3	0	9

Then by rule the length must be multiplied by the quotient of square of ¼ girth.

Thus:

F.	I.	S.	T.	
25	6			And we have for the
3	0	9		answer, 78 ft., 1 in.,
76	6			1 sec., and 1 third.
1	7	1	6	
78	1	1	6	

Length in feet.	DIAMETERS IN INCHES.																
	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
10	49	61	72	89	99	116	133	150	175	190	209	235	251	287	313	342	363
11	54	67	79	98	109	127	147	165	192	209	230	259	278	315	344	377	400
12	59	73	86	107	119	138	160	180	210	228	251	283	303	344	375	411	436
13	64	79	93	116	129	150	173	195	227	247	272	306	328	373	408	445	473
14	69	85	100	125	139	162	187	210	245	266	292	330	353	401	439	479	509
15	74	91	107	134	149	173	200	225	262	285	313	353	379	430	469	514	545
16	79	97	114	142	159	185	213	240	280	304	334	377	404	459	500	548	582
17	84	103	122	151	168	196	227	255	297	323	355	400	429	487	531	582	618
18	89	109	129	160	178	208	240	270	315	342	376	424	454	516	562	616	654
19	93	116	136	169	188	219	253	285	332	361	397	447	480	545	594	650	692
20	98	122	143	178	198	232	267	300	350	380	418	470	505	573	625	684	728
21	103	128	150	187	208	243	280	315	368	399	439	495	530	603	656	719	764
22	108	134	157	196	218	255	293	330	385	418	460	518	555	631	688	753	800
23	113	140	164	205	228	266	307	345	403	437	480	542	571	659	719	787	837
24	118	146	172	214	238	278	320	360	420	456	501	566	606	688	750	821	873
25	123	152	179	223	248	289	333	375	438	475	522	589	631	717	781	856	910

Saw logs reduced to inch board measure.

Length in feet.	DIAMETERS IN INCHES.															
	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44
10	381	411	444	460	490	500	547	577	644	669	700	752	795	840	872	925
11	419	451	488	506	539	550	602	634	708	734	770	828	874	924	959	1017
12	457	493	532	552	588	600	657	692	772	801	840	903	954	1007	1046	1110
13	495	534	576	598	637	650	712	750	836	868	910	998	1033	1091	1135	1203
14	533	575	622	644	686	700	766	807	901	934	980	1053	1113	1175	1222	1295
15	571	616	666	690	735	750	821	865	965	1001	1050	1129	1192	1259	1309	1388
16	609	657	710	736	784	800	876	923	1029	1068	1120	1204	1272	1343	1396	1480
17	647	698	755	782	833	850	931	980	1094	1134	1190	1279	1351	1427	1484	1573
18	685	739	799	828	882	900	985	1038	1158	1201	1260	1354	1431	1511	1571	1665
19	723	780	843	874	931	950	1040	1096	1222	1268	1330	1430	1510	1595	1658	1758
20	761	821	888	920	980	1000	1095	1152	1287	1335	1400	1505	1590	1679	1745	1850
21	800	863	932	966	1029	1050	1150	1210								
22	838	904	976	1012	1078	1100	1204	1268								
23	876	945	1021	1058	1127	1150	1259	1322								
24	914	986	1065	1104	1176	1200	1314	1380								
25	952	1027	1109	1150	1225	1250	1369	1438								

Saw logs reduced to inch board measure—Continued.

To find the amount of lumber any log will make, first find the length of the log in the first or left-hand column. Then, on the top of the page, to the right, find the diameter, and under the same will be found the quantity of lumber your log will make. Calculated for any length log, from 10 to 25 feet, and for any diameter from 12 to 44 inches.

Of the Wedge.

The wedge is an inclined plane; the form of it, and the power applied to it, will be the resistance to be overcome, as the thickness of the wedge is to the length. It is a useful mechanical power, and in some purposes, excels all the rest; because with it we can effect, what we cannot do with any other in the same time. Its power may be computed in the following manner:

We will suppose the wedge to be twelve inches long, and two inches thick at the upper end, and tapering to a sharp edge at the other. The power to hold it in is as one to twelve resistance; that is, twelve resistance pressing on each side of the wedge; for if struck with a mallet, the whole power or force added to the whole force of the power in the stroke, is communicated to the wedge the time it continues to move. The effect is as the square of the velocity with which the

mallet strikes, multiplied into its weight. Thus, suppose a mallet weighing ten pounds, strike with five velocity, the effective momentum is two hundred and fifty; but if it strike with double the force, or rather velocity, then the momentum is one thousand; if the force of each stroke, except what may be destroyed by the friction of the wedge, is added until the sum of these forces amounts to more than the resistance of the body to be split, it must open; if the wedge does not move when struck, the whole force is destroyed by the friction; the less the inclination of the sides of the wedge, the greater the resistance we overcome, because it will be easier moved by the stroke.

Of Pumps.

I think it is requisite to mention the common pump for drawing water. All pumps should be so constructed as to work with equal ease, in raising water to any given height above the surface of the well. Pumps are chiefly designated by the names of force and lifting pumps. Lifting pumps are applied to wells ,etc., where the height of the bucket from the surface of the water should not exceed thirty feet. The movable valve should be cased with leather, which springs outward, and fits the tube, so that neither air nor water can pass by it. The handle of the pump is a lever, in-

creasing the power used six times the distance or length of the handle; between the pin on which it moves and the top of the pump-rod, to which it is fixed, should be nearly one fifth part of the length; when the lever is worked, the valve opens as it descends, letting the air or water pass through it; as it again ascends the valve shuts, and the water which is above the bucket is raised. There would be a vacuum between the valves, but the weight of the air presses on the surface of the water in the well, forcing it up through the lowermost valve; this fills the space between the buckets; as the valve descends the lowermost valve shuts, and prevents the water from descending again. But if the upper valve be set more than thirty feet above the surface of the water in the well, the pump cannot be made to draw, because the pressure of the atmosphere will not cause the water to rise more than thirty-two feet. The distance between the valve in the first one and the surface of the water in the well, should never exceed twenty-four feet, or from some imperfection of workmanship, or other causes, the pump will lose water, and will cease to act.

NOTE.—Hot liquor pumps, or any pumps employed in raising any fluid where steam is generated, require to be placed in the fluid as low as the bottom of it, on account of the steam filling the pipes, and acting as a counterpoise to the atmosphere; and the diameter of the pipes to and

from the pump, ought not to be less than two thirds of the pump's diameter.

The Screw.

The screw may be denominated a circular inclined plane, which is denominated the thread, fastened around the cylinder. It consists essentially of two parts, called the internal screw and the external screw. In a single turn of the screw the circumference of the cylinder is equal to the base of the inclined plane, and the distance between the threads is equal to its heighth. The power is generally applied to the screw by means of a lever, which describes the circumference of a circle at each turn of the screw. The screw is evidently of great use, both for pressure and raising great weights. If the distance of the thread be half an inch, and the lever fifteen inches, and the power applied be ten pounds, then the power will describe a circle of ninety-four inches, whilst the weight raises half an inch. Then as half an inch is to ninety-four, so is ten pounds to one thousand eight hundred and eighty pounds, the weight the engine would raise with ten pounds power. But this is with no friction on the screw. We know the friction to be great, but have no means to give an accurate calculation.

The following table shows the power of man or horse as applied to machinery.

APPLICATIONS OF THE POWER.	Lbs. Avr. at the rate of 220 feet per minute.	Lbs. Avr. at the rate of one foot per minute.
A man is supposed to be capable of lifting or carrying - - - - - - - -	27.273	or 6,000
A man is supposed to be capable of turning the winch of a crane with a force equal to - - - -	28.637	" 6,300
When the united efforts of two men are applied to the winch of a crane, the handles being at right-angles, each man exerts a force equal to - - -	33.499	" 7,350
A man is supposed to exert a power in pumping equal to - - - - - - -	17.335	" 3,814
In ringing in, man exerts a force equal to - - - -	38.955	" 8,570
And in rowing - - - -	40.955	" 9,010
The power of a horse is equal to - - - - - -	150	" 33,000

Measure of Solidity.

7.22	cubic inches make	1 gill.
28.88	" "	1 pint.
57.76	" "	1 quart.
231.04	" "	1 gallon.

NOTE.—By the statute of the State of New York, the gallon of dry measure shall contain ten pounds of pure water at its maximum density; the bushel, eighty pounds. These measures have this great advantage. The common pump, or spring water, fresh drawn, is sufficiently near the standard density to be employed in regulating them, in all cases, where scientific accuracy is not required.

RULES FOR CALCULATING LIQUIDS.

To find the number of United States gallons contained in any square or rectangular cistern, multiply the contents in cubic feet, and then multiply the product by 1728, the number of cubic inches in a cubic foot, and divide the result by 231, the number of cubic inches in a gallon.

Example.—How many gallons in a cistern which is ten feet long, five feet wide, and four feet deep. By rule: $10 \times 5 \times 4 \times 1728 \div 231$.

Thus 10
5
50
4
200 and

1728
200
345600 and

231)345600(1496.24
231
1146
924
2220
2079
1410
1386
24

A TABLE

Showing the capacity of Cisterns, Wells, etc., in Ale Gallons and Hogsheads, in proportion to their Diameters and Depths.

Capacity in gallons.		Capacity in Hhds, Ale Measure, 63 Gallons.								
Dia. in inches	Depth 1 FT.	FT. 6.	FT. 7.	FT. 8.	FT. 9.	FT. 10.	FT. 11.	FT. 12.	FT. 13.	FT. 14.
3	43.3	4.1	4.8	5.5	6.2	6.8	7.5	8.2	9.	9.6
3½	59.	5.6	6.5	7.4	8.4	9.3	10.3	11.1	12.1	13.1
4	77.6	7.4	8.6	9.8	11.1	12.2	13.5	14.8	16.	17.2
4½	97.5	9.3	10.8	12.4	13.9	15.5	17.	18.6	20.1	21.6
5	120.3	11.1	13.3	14.8	17.2	19.1	21.	22.2	24.4	26.7
5½	145.5	13.8	16.1	18.4	20.8	23.1	25.4	27.6	29.9	32.3
6	173.2	16.5	19.2	22.	24.7	27.5	32.	33.	35.7	38.4
6½	203.3	19.3	22.6	25.7	29.	32.2	35.5	38.6	41.9	45.1
7	235.8	22.4	26.2	29.8	33.7	37.4	41.1	44.8	48.6	52.4
7½	270.7	25.8	30.	34.4	38.6	42.9	47.2	51.6	55.5	60.1
8	308.	29.3	34.2	39.	44.	48.9	53.8	58.6	63.8	68.4
8½	347.7	33.	38.6	44.	49.6	55.2	60.7	66.	71.6	77.2
9	390.	37.1	43.3	49.4	55.7	61.9	68.1	74.2	80.4	86.6
9½	434.3	41.3	48.2	55.	62.	68.9	75.8	82.6	89.5	96.5
10	481.	45.8	53.4	61.	68.7	76.4	84.	91.6	99.	106.9
11	583.3	55.5	64.8	74.	83.3	92.6	101.8	111.	120.3	129.6
12	693.	66.	77.	88.	99.	110.	121.	132.	143.	154.

EXPLANATION.

Find the diameter in feet on the left hand of the column of the table; then move to the right on the same line till you come under the depth in feet, and you will have the answer sought for in hogsheads. Thus, if the capacity of a cistern be required whose diameter is 5½ feet, and depth 12 feet, we find opposite 5½ and directly under 12, on the same line, 22·2, which is the answer.

NOTE.—The above table will be found useful and very convenient in the construction of public reservoirs, as well as private cisterns, as it will enable any one at a glance to determine the dimensions in depth and diameter, to hold a given

number of hogsheads. For a private dwelling, the capacity should not be less than seven feet diameter by eight or nine feet deep. In the construction of reservoirs for the supply of tenders on railroads, the height should be double that of the diameter, in order to obtain a head of water, and thus save time in replenishing the tenders.

The preceding table was computed in English ale gallons, although in New York but one standard measure for all liquids exists.

Steel—Of the various degrees of Heat required in the Manufacture of Steel.

They are termed by the smith as the black heat, the red, or cherry heat, the bright red, or bright cherry red, the white, and the welding heat. The first named is the lowest heat; it is not visible in daylight, but shines in the dark with a brown color. The second is in daylight a blood-red crimson. The third, a yellowish red, gives the scales or hammer slag on the iron a black appearance. A white heat is that which the scales and iron appear of the same color. Steel does not bear the same degree of heat as iron without injury. The finest cast steel will hardly sustain a bright red heat without falling to pieces, rendering it imprudent to heat it higher than a middling or cherry red heat. Although

sensitive to heat, steel will bear much more forging than iron, if not previously injured by too great a heat. In forging steel, no heavy tools, or at least no heavy sledge, should be used. Open fires are not adapted to heating steel, because a great deal of air passes through them unburnt, which in passing over the hot steel deprives it to some extent of its carbon. The fires require a roof or arch of fire-brick, in order to secure the proper compression of the air; or the roof may easily be formed of the coal itself. When damp, if slack coal is thrown on the fire in a layer of two or three inches thick, it will cake together, and, after the loose coal below it is burnt, it will form a hollow fire like a bake oven, the cake roof reflecting an immense heat upon the material below it. In heating steel, particular attention should be paid to the purity of the coal, and to its freedom from sulphur. Fine coal, wet, is less injurious to steel than coarse dry coal of the same quality. The hardening of cast steel is to heat the steel to not more than a brown or cherry red heat; beyond that point it burns and becomes brittle in hardening. The usual method is to heat the steel to a certain point, and then very suddenly plunge it into cold water, tempering it afterward. Good steel is silver white, and when tempered properly will scratch pane glass, or a file. In hardening steel, the hardness is derived not so much from the degree of heat to which the

metal is subjected as to the degree of cold of the cooling fluid, and the manner in which the cooling is performed.

Steel must be heated to a certain degree to assume its greatest hardness; if heated below that point, it will not become hard, no matter what kind of cooling fluid you employ. If the proper degree of heat be obtained, it is in your power to make the steel more or less hard, by choosing more or less cold water, or other fluids, for chilling it. Pure well water, taken fresh from the well, is the best element to cool it in; and it should be renewed at each operation. Hard well or spring water is preferable to that of a softer quality, and should be obtained if possible. Steel treated in this way assumes its greatest degree of hardness, and may afterward be tempered to any extent. The manner of cooling is of importance. If hot steel is held quietly in cold water, it will not become so hard as may be desirable, because the steam formed on the hot surface will prevent its rapid cooling. It should be moved backward or forward, or up and down, in the water, which greatly increases the hardness. For hardening large objects, a current or fall of water is indispensable. The surest method is to impart to the steel, in the operation of hardening, the greatest degree of hardness of which it is susceptible, and temper it afterward. If the steel is hotter, and the water colder, it will assume a greater degree of hardness,

or become brittle. By the same degree of heat in the steel, water, with ice or snow in it, will make the steel harder than water alone. Steel, heated to its highest point, and plunged in the coldest medium, becomes what is termed glass-hard, that is, it will scratch glass; but it is usually very brittle. If hot steel is thrown to the bottom of a vessel of cold water, it does not assume a high degree of hardness; but if a rapid motion is given to it, it speedily becomes hard, and the hardness increases with the rapidity of the motion. A well forged and polished rod of sound steel, if suspended by one end, and struck by any hard substance, emits a sonorous, silvery tone. There is no comparison between the sound of iron with steel.

Composition for Welding Cast Steel.

Take of borax ten parts; of sal ammonia, one part; grind or pound them roughly together; then fuse them in a metal pot over a clear fire, taking care to continue the heat until all spume has disappeared from the surface. When the liquid appears clear, the composition is ready to be poured out to cool and concrete; afterward being ground to a fine powder, it is ready for use.

To use this composition, the steel to be welded is raised to a heat which may be expressed as a bright yellow; it is then dipped among the weld-

ing powder, and again placed in the fire, until it attains the same degree of heat as before; it is then ready for hammering.

Directions for Making and Sharpening Mill Picks.

It is one of the most difficult things a miller has to contend with, to find a smith who can make and sharpen a mill pick, and temper it to carry a sharp edge that will crack hard burr mill-stones, from not knowing the nature of cast-steel. Often the millers have to send their picks a long distance to be sharpened. Under these circumstances, I have thought it right to give some instructions, which, if correctly followed, will enable the miller to sharpen his own picks; or, he may teach the smith in what way to temper or sharpen them. It is impossible to do their work well if the picks be not well hammered, and of the correct temper; they will be brittle, and fly on the edge, or they will be soft, and batter up, and will not cut. If the steel is heated too much, it will, when being used in picks, crumble on the edge; it is therefore necessary you should be particular in choosing good steel, for when the steel is bad, the picks will not be of any essential use to you.

The working of cast-steel picks, so that they will keep a sharp, even edge, whilst working on a

hard mill-stone, is done as follows: The steel or picks should be heated with charcoal or coke; if they are not to be found, the fire should be made of cinders, as fresh coal will, in general, have too much sulphur, which will make the steel too brittle and rotten. In commencing to make new picks, you first cut the steel off its proper length for each pick. Great care should be taken to insure to all parts a uniform temperature. Let it be heated to a blood-red heat. The operation of heating and hammering must be repeated until it is made the shape, length, and size required; but do not leave the marks of the hammer on it when finished. Then comes the hammering, which should be done as follows: You heat one of the ends of the pick until it becomes of a cherry red. The work should be moved to and fro, to expose all parts alike to the fire; then lay it even and straight on the anvil, and commence hammering it quick and hard, using a small hammer. Finish the edge of the pick first (making it a little narrower, as when it is finished the sides will be of an even width), as these edges must not be touched after you commence hammering the sides. If one stroke of the hammer is made on the edge after, it will open the pores in the edge; the pick will crumble there, and will not cut. Dip the hammer in some clean water when working the end; this helps to close the pores as you hammer, and makes the steel more tough. If the edge of

the pick is not straight, it should be cut off. The edge, when it is finished, is left nearly a sixteenth of an inch thick, to prevent it from being burnt through in heating again for tempering.

After both ends of the pick have been made, as above described, they are ready for tempering, to do which the fire should be carefully attended to. By referring to the article on steel, you will find an accurate description of the fire necessary for tempering, together with several other little scraps of much-needed information here, which the tempering and making of picks, as well as other articles of steel manufacture, require. The pick should have sufficient time to heat or soak, moving it to and fro in the fire, that all parts may be heated alike. Watch it closely until it becomes of a cherry red color (if heated too much, it will fly, and if not enough, it will be soft), and when it is of the heat required, the end should be dipped in a bucket of clean water, about an inch from the point; take it out immediately, and hold it until it becomes of a white color. Work the other end of the pick in the same manner, keeping the end that is tempered at the same time cool by pouring water on it. Take particular care that no grease or oil is in the water you temper with, as grease spoils the picks. Thus, by a little practice, you can make picks that will do good work.

Another principle in tempering picks, is by mixing shavings of leather in the fire, to keep the

edges from cracking. When brittle substances crack in hardening, it is from the outside contracting, thus becoming too small to contain the interior parts. To save the edges from shrinking or cracking by hardening, a good way is to draw the edges of the pick through yeast or beer grounds, or any other sticky substance, and then through a little common salt and animal's hoofs roasted and pounded. This applies a little carbon to the outside, and renders the steel harder, and less disposed to crack; it also prevents the edge from being injured from the fire.

I have always found the greatest difficulty from the smith not hammering the picks sufficiently, so as to close the pores and make them tough. The following is a receipt that was handed me, but one which I have never tried:

A COMPOSITION FOR TEMPERING CAST STEEL MILL PICKS.

To three gallons of rain water, add three ounces of spirits of nitre, three ounces of hartshorn, three ounces of white vitriol, three ounces of sal ammoniæ, three of alum, and six ounces of salt, with two handfuls of the parings of horse's hoof. The steel to be heated a dark cherry red. A large jug of this preparation should be kept corked tight, that it will not evaporate nor lose its strength.

Governors for Flouring Mills.

Milling should be carried on in the most profitable way possible. This is by making the best flour and yield; that is, to take out all the flour there is in the wheat.

I have thought proper, in this work, to introduce the governor to steam and water flouring mills. Every one must acknowledge that, when attached to the stones of a wind mill, they regulate their grinding evenly. When the stones are set properly they will not vary; the wind may blow hard or soft, the governor raising or lowering the stone as the wind may blow.

I have never seen the governor for regulating the mill-stones in a steam or water mill; but I feel convinced these governors will be used in general, both in steam and water mills, at an early day. I feel confident that, if the governor is properly put up, it will pay for itself in a very short time. Every miller knows that there is a great loss in the yield of flour in stopping and starting the mill, as there is seldom but one miller to attend to setting the stones. There must then be, of necessity, a great loss before the stones are set properly, losing considerable wheat that is partly ground, which goes into the offal.

I believe the governor can be so arranged in a mill that it will not interfere or disarrange any of

the other machinery of the mill, as they may be driven by a pulley from the upright shaft or the spindle of the mill-stones, and it requires but little power to drive them. They are made similar to the governor of a steam engine. Sometimes, in a wind mill, they have four balls attached; to others only two are attached. I prefer using them with two balls. The pulley may be placed on the horizontal shaft, above the balls or below them, to suit. I give this cut as a model, and the principle on which the efficacy of it depends is easily explained. (*See figure* 10.)

The heavy balls B B are attached to metal rods A A, which work on pivots C C, with shoulders that project into the upright axis D D, and become attached to a rod, which works freely within the upright axis D D. Now, by the revolution of the axis D D, the balls B B acquire an obvious tendency to fly off from the axis, and this tendency is stopped or resisted by the weight of the balls, so that when the axis is revolving with a certain velocity, the balls will remain suspended. It follows that, when the balls diverge from the axis, the shoulders of the arms A A will operate upon a pivot C C. The balance beam E is made with a crook in it, so that the balls will not interfere with it when running. At the end next the collar C are two prongs fitting in this collar; the straight part is made of steel, the same as a steelyard beam, only the notches are fine on the top

and bottom, as seen in E. A rod of iron G is made fast to a beam I at one end, the other end with a mortice for the balance beam to go through; this mortice is made of the best of steel, to fit on one of the notches, so that you can move it to any part necessary to take off the leverage or add to it. You then have a rod of iron, one end fixed to the end of the bridge-tree K, the other end with a mortice, which should be made of steel. The balance-beam E to go through, hanging on one of the notches at the top. This can be altered to give more or less leverage to regulate the stone when grinding. Silent feeders will act with the governor; for when the mill runs slow they will give less speed, the governor raising the stones in exact proportion to their speed. These balls should make forty revolutions or thereabouts per minute, and their circumference, for three run of stones, should be eighteen or twenty inches.

The Governor or Regulator.

The length of pendulums given to find the number of revolutions per minute.

Rule.—Divide 375 by the square root of the pendulum length, and $\frac{1}{2}$ the quotient will be the velocity required.

Example.—What number of revolutions per

minute ought a governor to make, whose pendulums are 25 inches long?

Thus: The square root of 25 is 5.

Then, according to rule, divide 375 by 5, which is 75, the quotient; but the rule requires the answer to be one half the quotient 75, which is $37\frac{1}{2}$, the number of revolutions per minute.

The revolutions of the governor given, to find the length of the pendulums.

Rule.—Divide 375 by twice the number of revolutions given, and the square of the quotient will be the answer.

Example.—When the velocity of the governor is $37\frac{1}{2}$ revolutions per minute, what ought to be the length of the pendulums?

Thus: Twice the number of revolutions $37\frac{1}{2}$ is 75. Then, according to rule, divide 375 by 75, and we have the quotient 5; which, squared, gives 25 the answer or the length of the pendulums.

The Pulley.

A pulley is a mechanical assistant, by which a great deal of power is obtained in a small compass; but more in accommodating the direction of power to that of resistance, as by pulling downward we are able to draw a weight upward. The advantage gained being twice the number of

moveable pulleys. As pulleys are very simple, this may be ascertained as follows:

Rule.—To find the weight that may be raised by a given number of pulleys, fixed or stationary, multiply the power by twice the number of moveable pulleys, and the answer is the weight the power equals.

A single pulley may be so constructed that the weight will be as three times the power, where more than one rope is used. In a range of pulleys where the ends of one rope are fastened to the support and power, and the ends of the other to the lower and upper blocks, the weight is to the power as 4 is to 1. The principal objection to this, is the loss of power by friction of the pulleys.

Example.—Find the weight that a power of 175 pounds will raise by a block and tackle, the bottom or moveable block consisting of four pulleys. Thus:

Multiply, as in rule, the power 175 by twice the number of moveable pulleys, 4, which is 8.

8 times 175 is 1400, the answer.

Example 2.—What weight will be balanced by a power of 125 pounds, attached to a cord passing over 5 moveable pulleys. Thus:

Multiply, as in rule, the power 125 by twice the number of moveable pulleys, 5, which is 80.

10 times 125 is 1250, the answer.

The simple pulley consists of a single wheel with

its cord, to one end of which is attached the weight, and to the other the power. No great mechanical advantage is gained by it, the weight being equal to the power. When a number of wheels are used, the whole are called a system of pulleys. In this case, it is explained that the weight is divided among the strings. To find the weight that may be balanced by a given power, or to find the power necessary to support a given weight:

Rule.—Multiply the power by twice the number of moveable pulleys, and the answer is the weight; or divide the weight given by twice the number of moveable pulleys, and the answer will be the power.

Example 3.—What power, applied to a rope passing over a single moveable pulley, will balance a weight of 700 pounds.

Thus: Divide, as in rule, the weight 700 pounds by twice the number of moveable pulleys, 1, which is 2.

700, divided by 2, is 350, the answer.

Of the Velocity of Wheels, Pulleys, Drums, etc.

When wheels are applied to communicate motion from one part of a machine to another, their teeth act alternately on each other; consequently, if one wheel contains 60 teeth, and another 20

teeth, the one containing 20 teeth will make 3 revolutions while the other makes but 1. And if drums or pulleys are taken in place of wheels, the effect will be the same; because their circumferences, describing equal spaces, render their revolutions unequal; from this the rule is derived, namely:

Multiply the velocity of the driver by the number of teeth it contains, and divide by the velocity of the driven. The quotient will be the number of teeth it ought to contain. Or, multiply the velocity of the driver by its diameter, and divide by the velocity of the driven. The quotient will be the diameter of the driven.

Example 4.—If a wheel that contains 75 teeth makes 16 revolutions per minute, require the number of teeth in another, to work into and make 24 revolutions in the same time.

According to rule, you multiply 16 by 75, and divide the product, which is 1200, by 24, and you have the answer) 50 teeth.

Example 5.—Suppose a drum, 30 inches in diameter, to make 20 revolutions in a minute, require the diameter of another to make 60 revolutions in the same time.

According to rule, you multiply 20 by 30, and divide the product, which is 600, by 60, and you have for the answer 10 inches.

Example 6.—A wheel 64 inches in diameter, and making 42 revolutions per minute, is to give

motion to a shaft at the rate of 77 revolutions in the same time; find the diameter of a wheel suitable for that purpose.

According to rule, multiply 42 by 64, and divide the product, which is 2688, by 77, and you have for the answer 35 inches nearly.

$$77)2688(34\tfrac{70}{77}$$
$$231$$
$$378$$
$$308\ 70$$

Example 7.—Suppose a pulley 32 inches in diameter to make 26 revolutions, find the diameter of another to make 12 revolutions in the same time.

According to rule, $26 \times 32 \div 12 = 69\frac{1}{3}$—26 and 12)832 This will be seen to be $69\frac{1}{3}$

32

832

$69\ \frac{4}{12} = \frac{1}{3}$

Example 8.—Find the number of revolutions per minute made by a wheel or pulley 20 inches in diameter, when driven by another 48 inches in diameter, and making 45 revolutions in the same time.

According to rule, $48 \times 45 \div 20 = 108$. That is, 48 multiplied by 45 = 2160, divided by 20)2160 gives the answer, 108 revolutions.

108

A leather belt should have a velocity of about 1300 feet per minute, and not more than 1800 feet, or it will not last long. If the lightning

pulley is used too strong, it increases friction in the gudgeons of the shaft, and prematurely destroys the belt.

On Friction.

We have considered the action and effect of the mechanical powers, giving the mathematical theory.

If there were no such thing as friction, or rubbing of parts upon each other, machinery would have greater power; but it is allowed that nearly one fourth of the effect of machinery is destroyed by it. One professor of science writes that friction does not increase with the increase of rubbing power or surfaces; or, in other words, however the magnitude of the surface of contact may vary, the friction will remain the same, so long as the pressure is unchanged. As the friction of one surface moving upon another is in exact proportion to the pressure with which the surfaces are verged together.

Where no unguent is interposed, the friction of any two surfaces, whether at rest or at motion, is doubly the same as when they are pressed perpendicularly together. That is, where unguents are interposed, the friction depends upon the nature of the unguents, or upon the supply. For when wood on wood, wood on metal, or metal on wood,

the unguents should be of hog's lard and olive oil. Tallow as an unguent, where metals run on metals, is not recommended; it causing more friction than hog's lard. The best kind of metals for journal bearings is brass and cast-iron, as they produce the least friction without any unguent.

Belting Friction.

The friction by belting on pulleys is forty-seven for greased leather, when run on wood drums or pulleys; fifty for dry leather on wood; thirty-eight for oiled leather on cast-iron pulleys, and twenty-eight for dry leather on cast-iron pulleys.

I believe the cast-iron pulley to be far superior to wood, not only for the friction being less than wood, but its durability; and I think them less expensive. The face required to be turned off evenly and true.

I believe the reason pulleys are often made of wood is that some of the millwrights are not expert in the calculation of machinery; for, when made of wood, they can add or diminish the circumference, so as to run their proper speed. This cannot be done with the iron pulley. If their speed is in any way deficient, they must be replaced with new ones, causing heavy expense to the mill owner. I would say never to employ any one to build a new mill, except he is good at calculating the speed the machinery should run at.

On the Strength of different Bodies.

The strength of a body is that power which it exerts in opposing any force acting in a perpendicular direction to its length, as in the case of beams, levers, and so forth; for the principles of which observe the following: The strength of beams, and so forth, is invariably as their length, and directly as their breadth, and square of their depth. And if cylindrical, as the cubes of their diameter. Thus, if a beam six feet long, two inches broad, and four inches deep, will carry 2000 pounds, another beam, twelve feet long, two inches broad, and four inches deep, will only carry 1000 pounds, being twice the length.

Again, if a beam six feet long, two inches broad, and four inches deep, can support a weight of 2000 pounds, another beam of the same material, six feet long, four inches broad, and four inches deep, will support double that weight, being doubly as their breadth. But a beam of that same material, six feet long, two inches broad, and eight inches deep, will support a weight of 8000 pounds, being as the square of their depth. From experiments made to find the strength of various bodies of iron and wood, we will commence with one inch square, and one round bar of each, one foot long and loaded in the middle, which is nearly as follows, in pounds avoirdupois, as seen in the following table:

TABLE.

American Woods.

Names of bodies.	Square bar.	One third.	Round bar.	One third.
Oak - - -	700	233	530	177
Ash - - -	800	266	635	212
Elm - -	569	189	447	149
Pitch Pine -	810	270	613	204
Pine - - -	566	189	437	146
Cast-iron -	2580	860	2026	675
Wrought-iron	4013	1338	3152	1050

To find the strength of any beam, supported in the middle and loaded at both ends; or, supported at each end and loaded in the middle. Also, when the weight is between the middle and the ends. Likewise, when fixed at one end and loaded at the other.

Rule 1.—Multiply the strength of an inch square bar 1 foot long, as in the table, by the breadth and square of the depth in inches, and divide the product by the length in feet; the quotient will be the weight in pounds avoirdupois.

Example 1.—What weight will break a beam of oak 4 inches broad, 8 inches deep, and 20 feet long between the supports?

According to rule, multiply the strength of an oak bar, 700 pounds, by the breadth, 4 inches, and multiply the product by the square of the depth, 8 inches, and divide by the length between the supports, 20 feet.

Thus: $700 \times 4 \times 8^2 \div 20$ . . 700
4
2800
8
22400
8
20)179200
8960

Then we have for an answer, 8960 pounds avoirdupois.

NOTE.—Again, when a beam is fixed at one end and loaded at the other, it will only bear $\frac{1}{4}$ of the weight as when supported at both ends and loaded in the middle.

Example 2.—What is the weight requisite to break a pine beam 6 inches broad, 9 inches deep, and projecting twelve feet from the wall?

According to rule, multiply the strength of a pine bar, 566 pounds, by the breadth, 6 inches, and then multiply the product by the square of the depth, 9 inches, and divide by the length from the wall.

Thus: $566 \times 6 \times 9^2 \div 12$ . . . 566
6
3396
9
30564
9
12)275076
22923

And we have for answer, 22923 pounds avoirdupois. But, as note says, when loaded from the wall it will only bear $\frac{1}{4}$ as much. We must divide 22923 by 4, and the answer, 4)22923, will be the weight required.

$$5730\tfrac{3}{4}$$

Note.—The same rule applies, as well, to beams of a cylindrical form, with this exception, that the strength of a round bar is, as in the table, multiplied by the cube of the diameter, in place of the breadth and square of the depth.

Example 3.—Require the ultimate transverse strength of a solid cast iron cylinder, 12 feet long and 5 inches in diameter.

According to rule, multiply the strength of a cast-iron bar (round), 2026, by the cube of the diameter, 5 inches, and divide by the length of the cylinder, 12 feet.

Thus: $2026 \times 5^3 \div 12$ 2026

5

10130

5

50650

5

12)253250

$21104\frac{2}{12}$

And we have for the answer, 21104 pounds avoirdupois as the weight requisite.

Falling Bodies.

Bodies descending freely by their gravity, in vacuo, or in a non-resisting medium, are subject to the following laws. Gravitating bodies attract each other with forces varying inversely as the squares of their distances.

Their velocity is always in proportion to the time of their fall, and the times are as the square root of the distance fallen. It has been ascertained by experiment, that a body falling freely from rest will descend $16\frac{1}{2}$ feet in the first second of time, and will then have acquired a velocity which, being continued uniformly, will carry it through $32\frac{1}{6}$ feet in the next second, and so on, in proportion to its fall.

TABLE

Of falling bodies in motion, supposed in vacuo.

Distance passed through in feet.	The velocity acquired by the fall in feet and parts per sec.	Seconds of time that a body is supposed to be falling.	Distance passed through, in said time, in feet and parts.	Velocity per second required at the end of every second, in feet and parts.
1	8.1	.125	.25	4.
2	11.4	. 25	1.01	8.1
3	14.	. 5	4.05	16.2
4	15.2	. 75	9.11	24.3
5	18.	1.	16. 2	32.4
6	19.84	2.	64. 8	64.8
7	21.43	3.	145. 8	97.2
8	22.8	4.	259. 2	129.6
9	24.3	5.	305.	162.
10	25.54	6.	583. 2	194.4

Of the different Gearings for propelling Machinery.

A cog-wheel is the name for any wheel which has a number of teeth round its circumference. Wheels consist of a round piece of wood, iron, or other metal, which revolves on an axis. The wheel is one of the principal mechanical powers, and has an important place in machinery. The centre of a wheel is like the fulcrum of a lever, and a simple action nearly transfers the force on one side to the other side.

The wheel and axle is a kind of lever, which has a continued motion about its fulcrum or centre of motion, where the power acts at the circumference of the wheel, whose radius may be round one arm of the lever, the length of the other arm being the radius of the axle on which the weight acts. If the power acts at the end of a handspike fixed in the rim of the wheel, then this increases the leverage of the power by the handspike.

The wheel and axle consist of a wheel having a cylindrical axis passing through its centre. The power is applied to the circumference of the wheel, and the weight to the circumference of the axle; for the wheel and axle being nothing else but a lever so constructed as to have a continued motion, since the velocity of any body on a lever depends upon its distance from the fulcrum. If

wheels can be so constructed as to diminish their velocity, then there will be power gained.

Of all the modes of communicating motion, that most extensively used is the employment of wheel work, which is capable of varying its direction and velocity without any limit. Wheels are made to act sometimes by simple contact with each other; sometimes by the intervention of cords, straps, or chains passing over them.

Wheels are denominated, spur, crown, or bevel, according to the direction or position of the teeth. Where the teeth of a wheel are made of the same material, and formed of the same piece, as the circumference of the wheel, they are then called teeth; when they are made of wood, or some other material, and fixed in the circumference of the wheel, they are called cogs; in a pinion, they are often called leaves, and in a trundle, stares.

Two wheels, acting upon one another in the same plane, are called spur gears; when they act at an angle they are called bevel gears. If the teeth are perpendicular to the axis of the wheel, and in the direction of its radii, it is called a spur-wheel; if the teeth are parallel to the axis of the wheel, and, therefore, perpendicular to its frame, it is called a crown-wheel. Two spur-wheels, or a spur-wheel and pinion which work in one another, are always in the same plane, and have their axis parallel; but when a spur and crown are in connection, their plane and axle are at right angles.

When the teeth are oblique to the plane or axis, it is called a beveled wheel, the use of which is to produce a rotary motion round another which is oblique to it.

Teeth of wheels and pinions require great care and judgment in their formation, so that they neither clog the machinery with unnecessary friction, nor act so irregularly as to produce any irregularity in the motion, and a consequent wearing of one part before another. The teeth of one wheel should press in a direction perpendicular to the radius of the wheel which it drives. As many teeth as possible should be in contact at the same time, so as to distribute the strain amongst them. By these means the teeth will be diminished during the action of one tooth on another. The direction of the pressure should remain the same, so that the effect may be uniform. The surface of the teeth, in working, should not rub one against the other, and should suffer no jolt, either at the commencement or termination of mutual contact. The breadth of the teeth should, in all cases, be four times their thickness.

The spur-wheel, in principle, is that of two cylinders rolling on each other, with the shaft or axis truly parallel. Here the touching parts of the cogs move with equal velocity, and have but little friction. If these wheels are fitted with wood, the cogs should be fitted to fill the mortices, and made strong, or they will assuredly give by the

stress of the work, and will cause those cogs that are coming into gear to touch the others too soon, and rub hard at entering. It is better for cogs to rub hard when they are coming out of gear than when coming in, as they then work with the grain of the wood; whereas, at entering, they work against it, and will wear much faster.

The cogs can be made as wide as is required, and their bearings may be large, that they will not cut, but polish each other and wear smooth.

A pinion is a small wheel which has, in general, a small number of teeth. When two wheels are mated together, the smaller is called the pinion or wallower.

The shafts cannot be changed from their first position in any of the wheels without detriment. When running, the pitch circle of these wheels should always meet exactly, and be rounded at the points.

When building a mill, it is bad economy to use wheels of too small diameter or too light; this should be carefully avoided. Knowing the pressure of the teeth, you should not reduce the diameter of the wheel below a certain measure.

The Crown or Face Gearing.—The principle of this gearing is that of two cylinders rolling with the side of one on the end of the other, their axles being at right angles. The greater the bearing and the less the diameter of the wheels, the greater will be the friction, because the touch-

ing parts move with different velocities; therefore the friction will be great. Their cogs standing parallel to each other, moving them a little out of, or in, gear, does not alter the pitch of the bearing parts of the cogs, and they will run smoother than other gearing when their centres get out of place. If the bearing of the cogs be small, and the stress so great that they cut one another, they will wear exceedingly fast; but if it be large and the stress light, that they only polish one another, they will last a long time.

The principle upon which the bevel gears act is as that of two cones rolling on the surface of each other, their vertices meeting in a point, where the cogs of touching surface move with equal velocity in every part of the cones; therefore, there is but little friction. These cones are indented or fluted with teeth, diverging from the vertex to the base, become bevel gear, the teeth being smallest at the point of the vertex of the cone. These wheels are often cast, and require, before they are run, that the teeth be made to their size and pitch, that they will work easy. These cogs may be given almost any width of bearing, as they will then wear a long time. By these wheels the shafts may be set in almost any direction desired to produce the necessary movements. They require to be kept of the right depth in gear, so that the pitch circles meet constantly, else they will not run smoothly.

I would recommend, when building a mill, to

have all the wheels of an equal diameter, or as near as you possibly can, so as to get up the required speed. Large wheels working in small ones require a greater power to drive them, on account of friction.

The pinion for driving the mill-stones should be of a large diameter; I believe nearly one half the diameter of the spur-wheel. By so doing, the stones will run better, as well as *all* the machinery, without trembling, and will take less power.

It is common with millwrights to put in small wheels for driving the bolts; when this is done to a bolting chest, any one may know that it takes more power to drive them, as the leverage is small; the power acting on the shaft or fulcrum.

I believe these wheels should be of nearly the same diameter as the bolts; this will give them leverage, and save a great deal of power to drive them. In some large wheels, I would recommend one of the wheels to be filled with wooden cogs; they generally running better, and not so liable to break, and causing less tremor in the machinery.

It is always admitted by mechanics that double-gearing diminishes power by the increased resistance to motion, as that of friction; as the more machinery used for a given purpose, the more it tends to complication, and the increasing power causing agent friction. It should be admitted, also, that less power can be obtained by two engines than by one, while the velocity of the body

moved remains the same; and machinery requiring a different velocity, where the driving power is the same (as is the case in flouring mills, the motion being as varied as the different useful machines required in the manufacture of grain). Every part of the machinery should be as near as possible to the first moving power; thus producing a constant tendency to equilibrium in all machines requiring a great velocity, as the greater the distance from the first moving power, the greater the resistance to motion,

After the foregoing remarks, it will be natural that I offer some hints to instruct the miller, or others, how to fasten or hang a wheel so as to work correctly. Whenever it becomes loose on the axis, or requires altering, we are confident that all the machinery will feel the effects of the motion when the wheel is hung untrue. If it can conveniently be done with a small wheel, the shaft should be taken down, and two pieces of wood cut out in the middle of the piece, in the form of a half circle, to correspond with the gudgeons—one of these pieces to be nailed to the top of a trestle, the other pieces to be nailed to one more trestle; the gudgeons of the shaft to be laid in them—and the shaft secured so that it will not move endwise; put the wheel to its proper place on the shaft, and nail a board on the trestles; if the shaft has four sides, stick a wedge in each, to hold the wheel in its position; then number the four quarters of the

wheel, such as one, two, three, four; turn the wheel so that one of the numbers is even with the top of the board; lay a straight strip of wood, one edge even with the quarter mark—say No. 1—to correspond with the edge of the tooth at the outside of the rim of the wheel; make a point mark on the board; then turn the wheel to the opposite quarter mark, No. 3, marking the edge of the slip on the board the same as the first.

You then perceive which wedge or key wants altering. Turn the wheel to the two other quarter marks, 2 and 4, and alter the keys until the four marks meet in one point. Nail a piece of board near the front end of the cogs with the slip of wood, one edge being even with the length of the cog, and at its quarter mark. Mark on the board in the same way. First, these four marks should be made to correspond; this is done by altering the keys, being careful not to drive the keys too hard, until the wheel is perfectly true, The keys or wedges should be of iron, and filed so that they will have a true bearing their whole length when finished.

The pulley or driver is worked and made true the same as cog-wheels. It is best to have the pulleys made of iron, though they are in general made of wood. Their speed may be altered by enlarging or diminishing their circumferences, and they should always be made a little rounding in the middle of the circumference, to keep the strap

from slipping. By the use of straps or belts, machinery may be made to run in almost any direction, from a horizontal shaft to a perpendicular one; this is by the strap being changed from its position by a tightening pulley, set at an angle, so as to lead the strap from the driving pulley to the leading one.

I would recommend the shaft to be made round, of iron, and the wheels to be bored out and hung true at the foundry, having one key to fasten them. When correctly done, if they become loose they are easily fastened and put to their proper place, without varying from their first position.

On matching Wheels to make the Cogs wear even.

Great care should be taken in matching or coupling the wheels of a mill, that their number of coggs be not such that the same cogs will often meet; because, if two soft ones meet often, they will both wear away faster than the rest, and destroy the regularity of the pitch; whereas, if they are continually changing, they will wear regularly, even if they be at first a little irregular.

For finding how often wheels will revolve before the cogs meet again, take the following:

Rule.—1. Divide the number of cogs in the greater wheel by the number of cogs in the lesser

wheel, and if there be no remainder the same cogs will meet once every revolution of the great wheel.

2. If there be a remainder, divide the number of cogs in the lesser wheel by the said remainder; and if it divide them equally, the quotient shows how often the great wheel will revolve before the same cogs meet.

3. But if it will not divide equally, then the great wheel will revolve as often as there are cogs in the small wheel, and the small wheel as often as there are cogs in the large wheel, before the same cogs meet. They never can be made to change more frequently than this.

Example.—Wheels of 17 and 13 cogs. Required, how often each will revolve before the same cogs meet again.

Thus: 13)17(1
13
4)13(3
12
1

Great wheel 13, and small wheel 17, revolutions. —Answer.

Proof.—Large wheel turning has four more cogs than the small wheel; therefore,

1	time	round	is	equal	to	1 round,	4 cogs.
2	times	"	"			2 rounds, 8	"
3	"	"	"			3 " 12	"
4	"	"	"			5 " 3	"

5 times round is equal to 6 rounds, 4 cogs.

6	"	"	"	7	"	11	"
7	"	"	"	9	"	2	"
8	"	"	"	10	"	6	"
9	"	"	"	11	"	10	"
10	"	"	"	13	"	1	"
11	"	"	"	14	"	5	"
12	"	"	"	15	"	9	"
13	"	"	"	17	"	13	"

Thus, you see, the large wheel revolves 13, while the small one revolves 17 times before the same cogs meet again.

Of Steam and the Steam Engine.

Steam, as a power for propelling machinery, is one of the best and most useful now in use. I believe it to be, in some instances, better than water; for they can be built almost in any situation where there is plenty of fuel to be obtained; besides, they may be run with nearly the same expense; that is, the breaking and repairing of dams, raising and falling of the water in the streams, and so forth, causing the stoppage of the mill, and great loss of time. This is not the case with the steam mills, which can run nearly all the time.

The following sized engine is sufficient to drive 2 run of 4 feet mill-stones:

One cylinder, 12 inch bore, length of stroke $3\frac{1}{2}$

feet, to be supplied with steam from 2 boilers—double flues—40 inches in diameter and 30 feet long. Boilers and engines of this size will drive 2 run of stones, with all the necessary machinery for flouring and custom work; and a mill of this size, when properly constructed, will grind from 100 to 130 barrels of flour per day.

Steam, as applicable at present to the steam engine, is highly rarefied water, the particles of which are expanded by the absorption of caloric.

Water rises in vapors at all temperatures, but is confined to the surface of the fluid acted upon until it has attained 212° Fahrenheit, called the boiling point; at that heat steam ascends through it, presenting its elevation to a higher temperature by carrying the heat off in a latent form.

The latent heat of steam at the common pressure of the atmosphere, according to accurate experiments, is found to be 1000°; and that the sensible or thernometric heat = 212°. Now 212° — 32° =180°, and 1000° + 180° = 1180°; therefore, steam at 212° is highly rarefied water, containing 1180° of heat; hence, to find the latent heat of steam at any other temperature, subtract the sensible heat from 1180, and the difference + 32° = the latent heat.

Example.—Require the latent heat of steam whose sensible heat is 224°

Thus: 1180 — 224 + 32 = 988.

224 956

956 and 988 The answer 988° latent heat.

One cubic inch of water produces about 1700 inches of steam, at 212°, or the common pressure of the atmosphere; but the boiling point varies considerably, according to the pressure of the surface on the fluid, and of course materially affects the density of the vapor produced; thus, in a vacuum, water boils at about 90°; under common pressure, at 212°; and when pressed with a column of mercury 5 inches in height, will not boil until heated to 217°; each inch of the mercury producing, by its pressure, a rise of about 1° in the thermometer.

Of Engines—their Management, etc.

It frequently occurs that men take charge of engines without having much practical experience; therefore, I think it requisite to mention, in this work, a few plain rules for their guidance, hoping they may derive benefit from them.

Take out the piston, that there may be room to line the shaft of the fly-wheel and cylinder. First make the fly-wheel shaft in line with the centre of the upright shaft. It should then be levelled true, which is done as follows: fit a piece of board

in the cylinder-head where the piston works. With the compass find the centre and mark it. Make one for the other end of the cylinder, as follows: take two pieces of board of sufficient length, three inches wide, and one inch thick, placed straight and even; lay them over each other, making a cross, each to be cut and joined in the middle, and made fast. With the compass, one end in the centre, strike them off the same size that the circle of the inside of the cylinder is, fitting tightly; this is to fit in the end of the cylinder. Then make holes in the centres; these should be larger than the line. Drive a piece of iron in the floor, and fasten one end of the line, which should be in the centre of the hole; the other end should go through the cylinder and its centre. You then fit pieces of wood, even and true, in the collar on the wrist of the crank; divide it correctly, and find the centre, making a circular mark round the centre; this should be correctly done. Then nail a strip of wood near the end of the cylinder timbers and to them. Hold one end of the line to correspond with the centre of the wrist. Drive a nail in the slip of wood to fasten the line to, which must be well tightened, and even with the centre of the wrist.

The fly-wheel shaft must be set true by this line in the following manner: turn the crank until it is even and level with the cylinder timbers, to be under the line and near to it. If the centre on

the wrist does not correspond with the centre on the line, mark the difference on the collar or wrist: turn the crank to the opposite point, which will be above and near the line. If this centre does not correspond, mark the difference in the same way. Turn the crank up perpendicularly; prove this by a plumb-bob. Hold the line even with the centre mark of the collar, the bob pointing to the line. If it points on one side, you mark the difference on the collar. Turn the crank to the opposite point; hold the line again even with the cylinder line; if the bob points on one side of the collar centre, mark the difference on it. You then, from these marks, see which way the shaft needs moving to make it true, having each centre of the journal or collar corresponding with the cylinder line, and you can, by wedging, make it perfectly accurate. To line the cylinder is as follows: with the compass find the centre in the end of the fly-wheel shaft, the one nearest the crank; make a plain mark there; the line being through the cylinder, the other end is stretched and made fast the same as the first line, only that it must correspond with the centre of the fly-wheel shaft. The crank or wrist should be at the centre part of the line, at the farthest extremity from the cylinder. The line should correspond and be near the centre on the collar or wrist, it being opposite and even with the centre of the shaft. If the cylinder is out of line, it may be seen by the line

bearing on one side of the centre holes in the cylinder. It is brought correct by moving the cylinder until the line is in the centre of the holes, not bearing on them in any way, and true, with the centre mark on the wrist and opposite the centre of the fly-wheel shaft.

To set the slides so as to make them work easy, these should be set by the T head and its jaws or slides. This is done by cutting a piece of wood the same width that the jaws are apart; plane it straight and smooth, three inches wide and one inch thick; cut a square notch in each end half the thickness of the slides, and the same width the slides should be. The proper width is found by measuring the breadth of the T head. Find the exact centre between the notches which are at the bottom of the slip of wood; make a square mark there; set this slip on the slides, the centre mark on the middle of the line; move the slides close to the side of the notch; change the slip to different parts of the slides. When the line and centre on the slip correspond, lay the level across each, making them true and out of wind; they should then be screwed fast.

The jaws should work even on the T head, and the same on the slides. These are set and altered by putttng in and taking out the packing—which is mostly leather—setting the cam true, to prevent the engine from back-lashing or vibrating. First, the steam-valve should be set true, as follows

turn the fly-wheel slowly until the piston is at the extreme end of the cylinder; measure the opening in the steam chest; then turn the fly-wheel until the piston is at the other extreme end of the cylinder; measure the opening; alter the cam until the openings are equal. To prove if the cam is true, nail a piece of board on the floor near the outside of the rim of the fly-wheel; turn the engine slowly until the valve in the steam chest is at the extreme end—this may be seen by watching it; mark the rim of the fly-wheel even with the top of the board; turn the engine the same way, until the side valve is at the other end of the steam chest, marking the rim as before; then divide the space between these two marks and the dividing point, to correspond with the top of the board, and set the cams by them.

Give the cam about one fourth of an inch lead. When the above is correctly done, it will take off the vibration, and make the engine run well.

To pack the cylinder or piston, plait some packing yarn sufficiently tight that it will need driving. If cotton rope is convenient, I would recommend one coil put in first, driving it to fit tight; then fill the remainder of the chamber of the piston with the plated yarn, driving it tight and full, leaving room for the nuts to go on the bolts; screw the nuts evenly and alike until they are fast. The packing should be well soaked in beeswax and tallow before using it.

I would recommend metallic packing as the best for the cylinder of an engine, as it is more durable and less expensive when in use. It will save the packing, and, also, a great deal of labor.

The journals of the crank and the T head require close watching. If they are loose in the boxes, or too tight, they will run badly; thus, if tightened too much, they will heat and wear out the brass runners; if they are not sufficiently tight, there is danger of the keys flying out and breaking the engine.

All the valves belonging to the engine should be ground in with emory, to keep them from losing either steam or water. Care should be taken of them, as they will wear. When you find them leak, they should be ground over again. If suffered to remain long, when leaking steam, there may be new ones wanted.

The best kind of packing for the rest of the joints is metallic vulcanized rubber, commonly called rubber packing. This is prepared so that 300° Fahrenheit will not affect it. No other substance has so much elasticity which stands so high a degree of heat, or which may be used about all parts of the machinery, as this packing, where packing is necessary, namely: cylinder heads, mantrole plates, piston rods, steam chests, steam joints, stuffing boxes, etc. The common way that the joints were made used to be with lead.

I do not think it necessary to explain this manner, as it will soon be out of use.

The boilers require to be often cleaned out, and care should be taken to remove the scales and mud from adhering to the inside; otherwise, if the scales are suffered to remain, the boiler will burn and want repairing. It is necessary to try the gauge-cocks often, to see if there is sufficient water in the boilers. There is great danger in running after the water is below the lowermost gauge-cock. The flues should be kept cleanly swept.

Prevention of Incrustation in Steam Boilers.

All water contains a greater or less amount of soluble substance. In evaporating a portion of the water, a part of this substance is precipitated, and forms a covering in the interior of the boiler, which adheres to the metal. I believe a universal remedy does not exist. Charcoal is recommended as the most useful. The charcoal should be made of hard wood, broken into lumps, of a quarter to a half an inch in size. The fine dust should be sifted out and thrown away. The quantity of coal is in proportion to the water the boiler evaporates, and in proportion to the amount of impurities contained in the water. It has a greater affinity for any thing that causes the scales or incrustation.

Two bushels of coal will protect a boiler of thirty horse power for three weeks, when running; after which the old coal should be removed and a fresh supply charged. By these means a boiler may be kept free from the sediment adhering to it.

Another method of preventing incrustation in steam boilers is that of adding a very small quantity of muriate of ammonia to the water, which will have the effect of softening and disintegrating the carbonate of lime and other substances deposited by the water during its evaporation. The metal, whether copper or iron, has been found, by experiments, to be unaffected by the action of the salt. The quantity used for this purpose is one pound of muriate of ammonia for every 1500 or 2000 gallons evaporated.

Another method which is often used, is the introduction of potatoes and other vegetable substances, which will, in a great degree, prevent incrustation on the bottom and sides of a steam boiler; and animal substances, such as refuse skins, will accomplish it still more effectually.

Double Engines.

As fuel is one of the principal expenses in running steam mills, it necessarily occurs that every owner of a steam mill wishes to manufacture with as little fuel as he possibly can. This cannot be

when there is a double engine to drive machinery; for experience teaches me that a double engine takes nearly one third more steam than the single engine, to do the same amount of work. Some millwrights put them into mills, thinking them to be a steadier power. I can say, by experience, that a single engine, properly fitted up, with a large diameter fly-wheel, will far excel any double engine I ever saw run, and will not be as difficult to keep in working order. Besides, it will save a great deal of fuel. I have seen a great many double engines removed, and single ones put in their place; if they were of any advantage, this would most certainly not be the case. A good experienced millwright will not recommend them. If he does, I would naturally think he knows but little of the action of steam or steam mills.

The Fly-Wheel

Is generally made, throughout the country, five to seven times as large in its diameter as the stroke of the engine. The weight of this wheel is variable, and depends on the speed of the engine, and the manner in which the steam works; it is also regulated by the purpose for which the engine is intended.

To find the weight of the rim or ring of a fly-wheel for an engine.

Rule.—Multiply the constant number, 1368, by the given number of horse power that the engine is equal to, and divide the product by the diameter of the wheel in feet, multiplied by the number of revolutions per minute, and the quotient is the weight of the ring in hundred weights or nearly.

Example.—Require the weight of the rim of a fly-wheel proper for an engine of 20 horse power; the wheel to be 16 feet in diameter, and making 21 revolutions per minute.

Thus: 1368 × 20 ÷ 16 × 21. According to rule.

```
1368        16      336)27360(81.42
  20        21         2688
-----     -----       ----
27360  by 336          480
                       336
                      ----
                       144 nearly ½, say 42.
```

And we have for an answer, 81 hundred weights and $\frac{42}{100}$, or nearly; which, reduced to pounds, gives us 9114 pounds. For, in table, there are 112 pounds to the hundred weight.

```
Thus: 112 pounds
        81
       ---
       112
      896
     ----
     9072
Add    42 pounds.
     ----
     9114   "
```

I have taken for example a 16 feet fly-wheel, weighing 9114 pounds, as many mills are so con-

structed that a larger fly-wheel in diameter cannot be used, as the room is insufficient. We will suppose this fly-wheel, weighing 9114 pounds, to regulate an engine necessary for a mill of that capacity, to run two pair of four feet diameter mill-stones. The verge of the fly-wheel should have greater velocity than the verge of the mill-stone, from the fact of its being the leader. If it should be necessary to put an extra run of stone into the mill, it naturally occurs that it then requires a heavier rim to the fly-wheel.

Having made my calculations for an extra run of stone, I believe the weight of the rim of the fly-wheel ought to be in proportion to the running stone. We will suppose the running stone to weigh 1600 pounds; this should be added to 9114, which would make the fly-wheel weigh 10714 pounds for three run of mill-stones. I believe this will answer for any diameter fly-wheel, when an extra run of stones is required. Fly-wheels should be of as large diameter as you possibly can find room for; especially, when the motion of the engine is too slow to overcome the back-lash, so termed. They should always be the leader. If the verge of the fly-wheel does not out-travel the verge of the stone, it causes back-lash, making the husk frame tremble, and the machinery run badly. Reason will tell any one that when the verge of the mill-stone outruns the verge of the fly-wheel, the stones are checked up, when the crank is at its

dead point, until the fly-wheel catches up, and this is at every revolution of the crank. I would not have written so much about the fly-wheel, but for this reason. I have seen, in my travels, many mills that have run badly, solely on account of the diameter of the wheel being too small to allow it to outrun the mill-stones.

To make the engine do good work and run evenly, the fly-wheel should be properly balanced. This is done by weighing, as follows: the first wheel—the leader—should be taken out of gear, the caps taken off the journals and oiled. Divide the circumference of the rim of the fly-wheel into feet, making a plain mark with a sharp punch at each foot; chalk each with its number of feet, and then fasten a chain above, and at the outer side of the circumference of the fly-wheel, and hang a pair of steelyards to this chain. Then, with a string hitched to the rim of the fly-wheel, and having one of the punched marks corresponding with a stationary point near the rim, you move the weight on the steelyards until it moves the fly-wheel; mark on paper such weight. Continue thus weighing every two feet, marking the different weights. When it is all weighed, you will perceive the lighter parts, which deficiency can be remedied by filling with lead. When the fly is thus correctly balanced, the engine, having no back-lash, will run better.

TABLE

Of circumferences and areas of circles, in feet. Suitable for fly-wheels, etc., etc.

Diam.	Circum.	Area	Diam.	Circum.	Area.	Diam.	Circum.	Area.
6	18.849	28.274	15	47.124	176.715	24	75.398	452.390
7	21.991	38.484	16	50·265	201.062	25	78.540	490.875
8	25.132	50.265	17	53.407	226.980	26	81.681	530.930
9	28.274	63.617	18	56.548	254·469	27	84.823	572.556
10	31 416	78.540	19	59.690	283.529	28	87.964	615.753
11	34.557	95.033	20	62.832	314.160	29	91.106	660.521
12	37.699	113.097	21	65.793	346.361	30	94.248	706.860
13	40.840	132.732	22	69,115	380.133	31	97.389	754.769
14	43.982	153.938	23	72.256	415.476	32	100.531	804.249

A circle is a figure bounded by a curved line, called the circumference, every part of which is equally distant from a point within called the centre. The diameter is a straight line passing through the centre, and terminated both ways by the circumference.

Rule.—To find the circumference of any given diameter, multiply the given diameter by 22, and divide by 7.

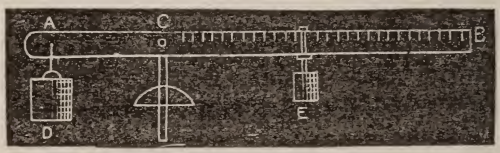
Example.—Find the circumference of a wheel 18 feet in diameter. According to rule, $18 \times 22 \div 7$.

Thus: 18
22
36
36
396 and 7)396 Feet. Parts.
$56\frac{4}{7} = 56.\ 548$, which is the answer. Or an example of 18 inches gives the same answer.

To calculate the effects of a Lever and Weight upon the Safety-Valve of a Steam Boiler, etc.

The lever, in all cases, is supposed to be made, finished, and balanced by a known weight or weights on the short end, making that point where it rests, or is attached to the valve, the centre of motion. Then that weight, added to the weight of the lever, is the effective weight upon the valve, independent of any other additional weight.

Thus:



There are three different ways that it may be required to calculate the levers.

Way 1.—When a certain pressure may be required upon the valve, the distance of the weight upon the lever, and distance of the valve from the centre of motion given, to find what weight will be required upon the lever at that distance.

I will also give three different rules, to correspond with the aforesaid different ways.

Rule 1.—From the required pressure on the valve, in pounds, subtract the weight of the valve, plus the effective weight of the lever; then multiply the remainder by the distance between the

fulcrum and the valve; divide the product by the distance between the fulcrum and weight, and the quotient is the weight in pounds, required to be placed upon the lever at that distance.

I will also give three examples, to illustrate the three ways and rules.

Example 1.—Suppose the lever A B (as in cut) to be twenty-four inches (24) in length, and the valve C placed five inches (5) from the centre of motion A, what weight must be placed upon the lever, twenty inches (20) from A, to equal 80 pounds; on the valve C, the weight of the lever being 2 pounds; the weight D, which balances the lever, $4\frac{1}{2}$ pounds, and the weight of the valve 3 pounds. According to rule, 80 — 3 + 6.5 × 5 ÷ 20.

Thus: 3 + 6.5 = 9.5 then 80.
3
9.5 then
70.5

70.5 20)352.5 then .5 then 17.625
352.5

In the division, we have $\frac{5}{20}$ remaining, which is equal to $\frac{25}{100}$. And we have for the answer 17 pounds, 625 thousandths of a pound.

Way 2.—When a certain pressure upon the valve is required, the weight upon the lever and distance of valve from the centre of motion given, to find where that weight must be placed.

Rule 2.—From the required weight upon the valve, in pounds, subtract the weight of the valve, plus the effective weight of the lever; multiply the remainder by the distance between the fulcrum

and the valve; divide the product by the weight in pounds upon the lever, and the quotient is the distance, in inches, from the fulcrum that the weight must be placed.

Example 2.—Suppose, as in the last example, the weight upon the lever equals 17.625 pounds, it is required at what distance from A the weight must be placed to equal 80 pounds at C. According to rule, $80 - 3 + 6.5 \times 5 \div 17.625$.

Thus: $3 + 6.5 = 9.5$ then 80. lbs. 70.5

3.		9.5 then	.5	17.625(352·500
		70.5	352.5 then	20

And we have for the answer, 20 inches.

Way 3.—When the distance of weight, distance of valve from the centre of motion, and weight upon the lever are given, to find what pressure is upon that valve.

Rule 3.—Multiply the weight in pounds, upon the lever, by the distance, in inches, to the fulcrum; divide the product by the distance between the fulcrum and the valve, and the quotient, plus the weight of the valve and effective weight of the lever, will equal the weight upon the valve, in pounds.

Example 3.—Suppose, as before, that a weight of 17,625 pounds is placed upon the lever, 20 inches from A, require the pressure at C; the distance from the centre of motion being 5 inches, and the effective weight of the lever, at that point, equals 6½ pounds; also, the weight of the valve 3

pounds. According to rule, 17.625 × 20 ÷ 5 + 3 + 6.5.

Thus: 17.625

20 then 5)352.500 70.5

352.500 70.5 then 3.

6.5

80.0 lbs. the ans.

NOTE.—It is generally supposed by mechanics that there is a pressure of atmospheric air of 14 pounds on the square inch. Therefore, as there can be no air in the boiler, this pressure must be on the top of the valve, which I have not accounted for in my calculations.

OF THE SIDE VALVE.

The lead of the valve (as it is termed by engineers) is a certain distance that the extremity of the eccentric must be in advance of the crank, so that the valve may be open, as required, when the piston is at the top or bottom of the cylinder, for this reason: at the return of the stroke, the steam in the cylinder may be of or nearly an equal density with the steam in the boiler; consequently, the nearer that the length of the aperture is to the area of the cylinder, the less lead is required.

Rule.—Multiply the square of the cylinder's diameter, in inches, by .002, and divide the product by the length of the aperture, also in inches;

the quotient will be the width that the valve must be open when the piston is exactly at the top or bottom of the cylinder.

Example.—Let a cylinder be 30 inches in diameter, with an aperture 12 inches long.

Thus: $30^2 \times .002 \div 12 = .15$ parts of an inch for the aperture to be open at the return of the stroke.

Suppose a cylinder 48 inches in diameter, with an aperture 16 inches long, and another 24 inches in diameter, with an aperture 8 inches long; it is evident that, although both apertures bear the same proportion to the diameter of the cylinder, and both valves move the same distance, the 48 inch cylinder would be twice as long in filling with steam as that of the 24 inch would be; for a cylinder twice the diameter is four times the area. Proof, $48^2 \div 16$, and the product, divided by $24^2 \div 8 =$ 2 times, or twice as long.

48
48
384
192
2304

and

16)2304(144
16
70
64
64

24
24
96
48

and

8)576(72
56
16

then

72)144(2 times, the ans.
144

then 576

Boilers.

The form of boilers has undergone frequent alterations since the first application of steam.

I find a great many are now using boilers with five or more flues in them. These will do for locomotives, or when there is not sufficient room, or not space enough for land engines.

I would not recommend any one, having sufficient room, to use boilers with more than two or three flues; for if there are more, the mill owner will regret it, after using them awhile. First, their cost is considerably more. Second, their durability is less. And thirdly, the increased danger of explosion by the collapsing of the flues. I believe, when the engineers have not been used to boilers having a number of flues in them, there is great danger of a collapse, as the foam these flues cause often deceives him; for, by trying the gauge-cock, the foam leads him to believe that there is plenty of water in the boiler, often causing an explosion.

I would much rather have two short boilers than one long one, on account of having more fire surface; it being always necessary to have as much fire surface as possible, to make the best use of the fuel; as the hotter the furnace is kept, the less fuel it takes to do the same amount of work. Besides, when there is a large furnace it gives the fireman

a better chance to keep the steam regular; for when cleaning out one part of the furnace, he can keep a hot fire in the other, so that the steam will remain regular.

This cannot be done with one long, five or six flued, boiler; as when the great bars have to be cleaned, the steam is gone, causing a loss of time and great trouble.

A boiler 30 feet long and 3 feet in diameter, will afford $30 \times 3 \times 3.14 \div 2 = 141.30$ square feet of surface, or steam for 14 horse-power, if 10 feet are assumed for one horse-power.

In setting a boiler, you should make arrangements in the furnace to carry on combustion under the highest possible heat. This requires good non-conductors of heat, such as brick, with which to surround the fire. If these bricks are of a white color, the combustion is more perfect than if of a dark color. The roof, as well as the sides, of the furnace should be of white fire-brick, if you would secure a good combustion. A good brick roof over the fire, and between it and the boiler, better secures a perfect combustion than any other.

It is of advantage to have the grate surface rather too large than too small. For each horse-power of the engine there ought to be at least one square foot of grate. If there are three square feet to each horse power it will be better. The spaces may be narrower between the bars for wood and pure coal than for impure and sulphurous

coal, as the clinkers adhere to the grate bars, and diminish the access of fresh air.

The firing should be attended to, so that the most steam can be made out of the least fuel. The bars should be eighteen or twenty inches below the boiler or crown of the furnace. The fire should be kept thin and open, and supplied sparingly and frequently, to allow the air to enter between the bars, for the better combustion of the inflammable gases. The bars should slope downward toward the back part, about half an inch to the foot. The ash pit under the fire should be often cleaned out and not suffered to accumulate; otherwise it will stop the draft and burn out the bars, taking more fuel.

Thus, the gases produced in the furnace are led under the boiler, and are frequently returned in a pipe or pipes which pass through the boiler. Chambers are generally used, or partitions between the walls. These partitions should be about six or seven feet apart, made nearly up to the boiler. As the smoke or heat passes over these bridges it will pass into these chambers; by so doing they will save considerable fuel, the heat not escaping up the chimney. The chambers under the boiler are of great effect in forcing the air into a turbulent mixing motion, and induce its contact with the boiler. Gas at rest, or moving in a close column, conducts heat poorly; but if in a disturbed condition, it is a very efficient conductor.

Chimneys.

This is a subject that cannot be fully treated upon, as their locations are very different. I shall give a few plain hints on this subject, as follows: the first object of a chimney is to produce a draft; that is, a current of fresh, dry, atmospheric air through the coals in the grate. This draft is produced by the specific gravity of the air inside and outside of the chimney. The atmospheric air outside, if not as variable as the gases inside, is still subject to continual changes in composition, density, and motion. Moisture, temperature, and currents of air cause a disturbance in the current motion in a chimney.

The walls of a chimney should be made thick and tight, and painted white inside, as it is then a non-conductor of heat.

There is one object which requires very particular attention, and which must be of a certain size to produce the best effect; and that is, the flue leading from the boiler to the chimney.

A great many mills are built with a deficiency in the height of the chimneys. I have seen several that were too low, having but a small draft. If they were built higher they might have sufficient draft. Every chimney should be built several feet above the top of the mill-house, so that there is no obstruction to break the air from the top of the chimney.

It often occurs that steam mills are built in cities, and there is no room to blow the dirt and chaff outside from the smut-mill, without annoying the neighbors. When this is the case, you can, through a trough or pipe, blow it into the ash-pit, under the grate-bars. Besides, when the draft is insufficient, it will remedy the draft considerably.

Explosion of Boilers.

Explosion has been assigned to a variety of causes. The most of the explosions occur when the boiler has been at rest, and the generation of steam is sudden; or may happen when the capacity of a boiler for evaporation is tasked beyond its limits; the causes of explosion are, in both cases, about the same. In the former, it is the steam at rest during the interval of stoppage; in the latter, it is the highly urged fire. If the accumulated heat in the metal is the cause of explosion, we should prevent that accumulation, which is done by not overloading the boiler. When the engine is at rest, it is best to let a small portion of steam escape; this will keep the steam and water in the boiler in motion, and avert the danger arising from a state of rest.

The explosion mostly occurs when the water is low in the boiler; the cold water coming in contact with the iron when nearly red hot. If the

steam and water are at rest, the metal surface is covered with a layer of steam at rest, which may extend below the surface of the water. In case the engine is not at work, the safety-valve should be opened; not for the purpose of reducing pressure, but to produce motion.

On the Construction of Mill-Dams.

Mill-dams entail a heavy expense in keeping them in repair, when not constructed properly, or when poor materials are used. In building dams, some builders prefer stone, some frame or log, and others clay and brush. I will give a few plain hints for building mill-dams. I feel fully satisfied this might have been treated upon by more experienced mechanics than myself. As no work that I have seen has treated upon mill-dams plainly, I will give a few plain hints, which I hope may prove beneficial. When building a dam, you should select the most suitable place. If you can, conveniently, place it across the stream, near a rock bluff, so that the ends of the dam may run into the bluff. This will prevent the water from running by at the ends of the dam.

In building a mill-dam, great care should be taken to have it built strong. If this is not so, they are breaking up often, entailing a heavy expense for years, disheartening the owner, and often

proving his ruin. I have seen several dams broken or washed away by heavy floods when the mill has been running; stopping the mill for a long time, and costing nearly as much work in repairing as building a new one.

Rock-Dam.

A rock-dam I believe to be the best in use, if there is sufficient rock near for building materials, and with a rock bottom to the stream. In building a rock-dam, if the bottom of the stream is not composed of rock, you should dig a trench in the bottom, deep enough, so that the water cannot undermine it. This should be the same as if you were building the foundation of a large building. The wall to be built should be of a small, circular form, so that the back of the circle should be at the front, or next to the body of water, which may, by its pressure, tighten it.

To secure the water from breaking or leaking through at the ends of the dam, dig a ditch deeper than the bottom of the river; then fill this with small pieces of rock, and pour in cement. This cement is made of hydraulic cement, and is made of one of hydraulic to five of pure sand. This may be made in a tub and poured in; this will stop all the crevices, so that the water will not break through.

By building a rock-dam, if properly managed, it will be perfectly tight. I would recommend you to use as large rock as you conveniently can move; building this wall from four to six feet thick, according to the length of the dam, with jams or buttresses every place where they are needed to strengthen it. I would make true joints to these rocks, especially on the ends, so that they may join closely together. When you have the outside walls laid in cement, for every layer fill the middle up with pieces of small rock, pouring in your grout, so that there may not be a crevice but what is filled. If there is any small crevice or small hole left open, the water will break through, wearing it larger and larger. If the stream is wide and large, affording a great body of water, it is necessary to build the dam in two sections, which should be divided by a waste-way, necessary for the waste or surplus water to run over to keep the head in its proper place or height. Let each section, next to where the water is to be run over, be abutments, built to strengthen the dam. The last layer of rock, on the top of where the waste water runs over, should project five or six inches over the back of the dam; so that the water will not undermine the dam. This last layer should be of large rocks, and jointed true; then laid in hydraulic cement, in proportion of one of cement to three of sand. When the dam is built, the front should be filled up with coarse gravel or

clay; this is best done with teams, as the more it is tramped the more durable it will become.

The gate for letting the water into the mill-race should be nearly six feet, more or less; this depends on the amount of water necessary. This gate should be made of two or two and a half inch plank; the joints to be perfect, or even-fitted, so that the water cannot run through. As the pressure is great, the bottom of the race, where this stone wall is built, should be secured with plank, to prevent the water from running underneath the gate. I would not recommend any mill to be built close to the stream of water, for this reason: they are in danger of being carried away by heavy floods. Besides, by digging a race, you can build them where they are easy to be got at, giving better roads, with plenty of room.

Frame Dams.

I now give a few plain hints on frame dams, as there are many situations where the stone dam cannot conveniently be built; besides, in many places the frame dam will be built cheaper than the rock dam. In building a frame dam, commence with a good foundation; laying the first sills in the bottom, of sufficient depth. These sills should be made of large, square timbers, that will last in the water without rotting. The bottom

made secure, so that the water cannot undermine or leak through. I have always found the musk-rat the most troublesome of any thing there is to contend with, as they will destroy almost any race or dam, if not properly secured. They are the miller's worst enemy, and should be every one destroyed. When you commence building a frame dam, where there is a soft foundation, the bottom should first be made level; then dig trenches for the mud-sills, about seven or eight feet apart, which are laid lengthwise of the stream, and some ten or twelve feet long. Into these first sills other sills should be framed, and put crosswise of the stream, some six or eight feet apart, to reach as far across the stream as necessary. Then two outside sills should be piled down with two-inch plank, driven down to a depth of four or five feet, If this can be done conveniently, they are to be jointed as closely as possible. It would be better to line with some stuff about three fourths or one inch thick. Then, with posts their proper length, about twelve or fourteen inches square, which should be framed into the uppermost sills, in both sides, and all the way across the dam, from bank to bank, at a distance of six feet apart. Then, with braces to each post, to extend two thirds of the length of the post, where they should be joined together with a lock, instead of a mortise and tenon, with an iron bolt of one or one and a quarter inches in diameter, going through both,

and tightened with a screw and nut. When mortises and tenons are used, they often become rotten and useless in a few years. These braces should be set at an angle of about fifty or sixty degrees, with the other end mortised into the mud-sill. These braces require to be of about eight to six inches, and as long as you find necessary. Being covered with the dirt, it will not decay for a long time, as the air is excluded. These posts should be capped from one to another, plate fashion. The posts should be lined with two or two and a half inch plank on the inside, and pinned to the post, and should, in the middle, be filled with dirt.

If the stream is wide, and affords a good deal of water, I would recommend the dam to be built in two sections, which should be divided by a waste-way for the surplus water, which should be in the centre of the dam, and sufficient for all the waste water to run over. Let each section of the dam form an abutment next to the waste-way; placing cells or sills four feet apart, the length of the waste-way; in each of these sills posts should be framed, with a brace for the sides. These rows of posts, standing across the dam, will form the sectional abutments; the middle one may be constructed by being lengthwise of the stream, with short braces, so that they will not be in the way of drift-wood passing down the stream; it being necessary for strong pieces for a bridge. Then cover the sills with an apron of two-inch plank

joined perfectly straight, to extend thirty or forty feet below the dam, to prevent the undermining of the dam. The planks which are used for the purpose of lining the posts, which form the abutments of each section of each dam, and the ends of the waste-way, should be truly pointed, so as to prevent any leakage. The dam being built, the dirt should be filled in with teams, as the more it is tramped the better. Clay or coarse gravel is the best. Then place your gates on the upper side of the waste-way, the size that is necessary to a level with low-water mark; which gates are not to be raised, except in times of high-water, as the proper height of the mill-pond should be regulated by boards placed over the gate for the desired head, as the water should be allowed to pass at all times freely over them. Flumes are built from the race to the water-wheel for an overshot, breast, or other kind. First, you place two large sills for the outside of the flume for its bearing; then cut notches in them, about fifteen or eighteen inches apart; have square timber, six or seven inches for the bottom, made straight and out of wind. Then set posts the length you require, about seven by four inches. These are to be mortised in the sills, and should all be set evenly, so that the plank will fit them all alike. These planks should be from two to two and a half inches thick, and free from knots or cracks. These are to be planed and jointed, so that they will not leak; then fit them

closely and spike them down; commencing with the bottom first. When finished, plank the sides in the same way. The sides to the flume should be so high that the water cannot run over the top. It will be requisite to dig a trench in front of the flume, longer than the race, and some two feet wide. This is to be deep enough, so that the water cannot run under the flume, or its sides. Fill this trench with brick, laid in hydraulic cement, or with rock broken up and put in. Then pour in grout, hydraulic, and sand. In all cases, you require the hydraulic cement to be of the best quality, and the first class, as there is a great deal used that is worthless.

There should be a gate in front of the flume, to be placed so that the water may be entirely shut out of the flume. This is entirely necessary when any repairs are required. Some small distance from the gate it is best to place a rack, to prevent the trash from lodging, or going to the water-wheel; for, by so doing, it will often save a great expense. To strengthen the dam, if you think necessary, two-inch plank may be used in lining the front side of the dam, long enough to reach from the bottom of the stream (on an inclined plane, and next to the body of water) to the top of the dam, and filled up nearly to the top of the dam with clay or gravel, well trampled down.

I think it necessary to have all dams built with

a small circle to them; the back of the circle always being next to the body of water. It tightens them by the pressure of water against them, they are not so liable to leak, and are considerably stronger.

Brush or Log Dam.

In small, muddy streams, these dams are very often used. I believe the proper way, and cheapest, when the bottom of the stream is of a soft texture, is, take a flat-boat where you want to fix your dam, and drive piles the whole length of the stream, about three or four feet apart, as deep as you can. Take young oak saplings, pointed at the end, for the purpose. If you can, construct a regular pile-driver, similar to those in use for making trestle-work on the railroads.

This weight may be pulled up with horses, instead of an engine. When you have finished driving piles, make some boxes or troughs of two or three-inch plank, about three feet wide, and as long as the plank is. Sink these in the water, the length of the dam, close to the piles, by loading them with rock, until they are at the bottom of the stream, filling in the front part of the dam with dirt and brush nearly to the height you want it. I believe this will be a permanent dam, and will last a long time.

Some dams are made with loose rocks, logs, etc.; but I think them not worth much. Therefore, I will say but little respecting them; only, when there is a small break in the dam or race, I never found any thing better than cutting up some willows and brush, putting that in the break, with straw and dirt, and ramming it down with clay; it is better than dirt.

Gates.

The form of a gate can never be too simple, as complicated constructions should be avoided, as gates are liable to be obstructed, in time of floods, by drift-wood, ice, etc., etc.; and if there is much machinery about it, vexations, detentions, and often serious damages arise from it. Gates made of oak, simply in the form of square boards, fitting well in their seats, are the cheapest and most practical form of gates. If they can be permanently submerged, their utility is still increased. Cast-iron gates, no matter how well constructed, are generally too heavy to be manageable; and, besides, are liable to break.

We will suppose a sliding gate to be made of oak plank, two inches thick, three feet wide, and three feet high, when made with its centre five feet below water. How much force is required to lift the gate? The weight of the gate is equal to

one and a half cubic feet of oak wood; it is to be always submerged in water, and its weight is nearly equal to the displaced water. The pressure of the water upon its centre is 60; this, multiplied by 5, then by 3, and then by 3, gives the weight.

Thus: $60 \times 5 = 300 \times 3 = 900 \times 3 = 2700$ pounds, the answer.

Description of Water-Wheels.

In water-wheels, the motion is generally obtained from the water by obstructions in its progress, or by moveable buckets being placed in its descent, and is one of the steadiest and best powers for propelling machinery. Water-wheels have various denominations, according to the manner in which they are constructed, such as the overshot, breast, and other water-wheels.

In the overshot wheel, the water acts on the wheel by its weight; it is delivered from the spout as high on the wheel as possible, that it may continue to press the buckets the longer down. The overshot wheel is also the most advantageous; as, from the same quantity of water, it gives a greater power. But they cannot be always used, the fall being too small; in which case, recourse is had to the breast wheel. The overshot wheel is furnished with buckets, so constructed that they shall retain as much as possible of the water, from the time

they receive it, until they arrive at the lowest point, where each bucket should be emptied; since, if any water be carried by the buckets in their ascent, it will just be so much unnecessary weight that the wheel has to lift. It should hang clear of the tail water; otherwise, the water will be drawn back under it. The head should be, generally, about three feet; it will then spout one third faster than the wheel moves. The shute should have three inches fall, and be made so that the water will run in the centre of the wheel; also pieces of wood or leather nailed on the slide, to keep the water from being wasted on the slides or runs of the wheels.

The proper motion of the wheel should be from three to four feet per second for all diameters of wheels. If these wheels are run too fast, there is a great loss of power, not having the full weight of the water. There should be a penstock or sluice to regulate the quantity of water and prevent waste; since, if the water was permitted to flow too rapidly, and splash out of the buckets instead of filling them, it would run down over the surface of the wheel without producing its proper effect. To prevent this, the water is seldom permitted to run on to the wheel in a stream of more than from half an inch to an inch in thickness; and when well regulated, there is scarcely a drop of water ineffectually wasted. The overshot-wheel, therefore, acts by the gravity

or weight of the water contained in the buckets, for nearly one third of its circumference. If the dimensions, quantity of water, and height of fall be the same, the overshot wheel will produce double the effect of any other wheel. As the overshot-wheel depends entirely on the weight of water which falls into the buckets, these latter should be as capacious as they conveniently can be made; not only that they contain as much water as possible, but allow ample room for the discharge of the air that will be thrown into them by the water, as well as by the ready discharge of that water when done with.

Great attention should be paid to mills, in their construction, to have the size of the water-wheel proportioned to the velocity of the stream and speed of the work it is required to perform; and this may always be accomplished, without waste or difference of power, by using a wider wheel of smaller diameter, when rapid speed is required; or a narrow wheel of great diameter, where this is not essential. In every case, the full power of the stream should be taken advantage of, in the first case, in constructing a mill; because it is a troublesome and expensive operation to increase the power of a mill when once built, and power is always valuable.

The wheel should be kept equally balanced, otherwise the power is not so steady. To effect this, when the mill is stopped for a time, the

machinery should be taken out of gear, and a small quantity of water let on the wheel to keep it moving, which will keep it equally wet all over, and not (as it is called) lopsided, and in balance.

The water should spout into the buckets as soon as they have passed the perpendicular centre of the shaft. There should always be placed a rack or grating in the shute, to prevent pieces of timber or wood from running on the wheel, breaking out the buckets, or doing it any other damage. This rack needs to be often cleaned, as the weeds or other substances collecting will prevent the water running to the wheel, thereby stopping the mill, or making the power irregular. The miller, therefore, should occasionally examine the wheel, to see if any of the buckets or floats are broken or loose; if so, they should be repaired immediately; for if they be permitted to run when breaking, they often entail a heavy expense. The gudgeons should be kept from heating by laying pieces of bacon on them; if that will not effect it, run a small quantity of water on them.

When building a water-mill, I would recommend a shaft that is made of iron, as they are more durable and cheaper in the end than those made of wood. In most of the cities where steamboats are built or repaired, these shafts are found, and, by a little alteration, will answer for the water-wheel shaft; they mostly having the flanges on them, which may be moved

to suit. The arms may be fitted in for the rims to rest on. I think one other great advantage is, in the winter the ice will not adhere to them, saving a great deal of labor, even if you should have a new shaft (of iron). I believe the expense will not be more than a wooden shaft.

In lining the water-wheels, whether overshot, breast, or undershot, care should be taken to have the joints of boards or planks made perfectly straight and closely fitted, so that the water cannot leak through these joints; if it does, in the winter the ice will accumulate inside the water-wheel, causing a great deal of trouble, and making the wheel run badly, it being lopsided.

Of Non-elasticity and Fluidity in Impinging Bodies.

Water, falling 4 feet, and striking a horizontal plane with 16 feet 2 inches velocity, will cast some few drops to the distance of 9 feet, allowing 1 foot to be lost by friction, etc., which we suppose take their direction at an angle of 45 degrees; because a body, projected at an angle of 45 degrees, has the greatest possible horizontal range. A body, falling 4 feet, its acquired velocity, 16 feet 2 inches, at 45 degrees, will reach 16 feet horizontal range, or 4 times the distance of the fall. By this rule, $\frac{1}{4}$ of 10 feet, equal to 2.5 feet, is the

fall that will produce the velocity necessary to this effect. On an undershot water-wheel, the water can be of no further service in propelling it, after the first impulse. It should escape freely after the first stroke.

Motion of Overshot Wheels.

I find, by different mechanics, the circumference of overshot wheels, geared to mill-stones, grinding to the best advantage, should move 550 feet in a minute; and that of the stones, 1375 feet in the same time. That is, while the wheel moves 12, the stones move 30 feet, or in the proportion of 2 to 5.

Then, to find how often the wheel we propose to make will revolve in a minute, take the following rule. First find the circumference of the wheel by multiplying the diameter of the wheel by 22, and divide the product by 7. Thus: suppose the diameter to be 16 feet; then 16, multiplied by 22, gives 352; which, divided by 7, gives $50\frac{2}{7}$ for the circumference. And to find the number of revolutions, we divide 550 by $50\frac{2}{7}$, which gives us 11 revolutions.

Thus: $16 \times 22 \div 7$, and $550 \div 50\frac{2}{7} =$ answer.

$$\begin{array}{r} 22 \\ \hline 32 \\ 32 \\ \hline 352 \end{array} \quad \text{then } 7\overline{)352} \quad \begin{array}{l} 50\frac{2}{7} \end{array} \quad \text{and then } 50\overline{)550} \quad \begin{array}{l} 11 \end{array}$$

And we have for the answer 11 revolutions. In dividing 550 by $50\frac{2}{7}$, we have dropped the $\frac{2}{7}$, it being too small.

2. To find the revolutions of the stone per minute.

Suppose the stone to be $4\frac{1}{2}$ feet, which is 54 inches. Then, 54, multiplied by 22, gives 1188; which, divided by 7, gives $169\frac{5}{7}$, say 170 inches for the circumference. And to find the number of revolutions, we divide 1375 feet; or, rather, 16500 inches by 170, which gives us 97 revolutions.

Thus: $54 \times 22 \div 7$, and $1375 \times 12 \div 170 =$ 97, answer.

54
22
108
108
1188 then

7)1188
$169\frac{5}{7}$, or 170; then

1375
12
16500 and

170)16500(97
1530
1200
1190
10 And we have for the answer 97 revolutions.

The Breast Wheel.

The breast-wheel is by far the most common, and may be considered a mean between the over-

shot and undershot wheels. In this, the water, instead of passing over the top of the wheel, or entirely beneath it, is delivered about half way up it, or rather, below the level of the axis; and the race or brick-work upon which the water descends, is built in a circular form, having the same common centre as the wheel itself, so as to make it parallel with the exterior edges of the float-boards, or extreme circumference of the wheel. These float-boards are made to fit as accurately as possible, without contact, into the circular hollow of the brick-work, so no water can escape past the wheel without producing its proportionate effect. Breast-wheels differ but little in their structure or action from the overshot, excepting that the water passes under, instead of over them; and they must be wider in proportion, as their fall is less practicable. Millwrights agree that there should be from six to ten feet fall, and a sufficient quantity of water.

The breast wheel, as I said before, is nearly allied to the overshot; for, notwithstanding it has only float-boards instead of buckets, yet, as the mill course is made concentric to the outside of the wheel, and is not only there, but at the two sides, made as close as convenient, so as to prevent the escape of water as effectually as possible, the spaces between one float-board and another become a bucket for the time being, and retain the water; and thus the breast wheel is not only

impelled by the weight of water, but by its impetus or momentum also. For the water should be confined, so as to be incapable of splashing or being lost, and its moving force, consequently, exerted to the greatest advantage. Yet, with all this apparent advantage, the breast wheel is, in effect, vastly inferior to the overshot wheel; not only on account of the smaller height at which the water is supplied, but from the waste with which (however particular) it is always attended. In practice, it is found that the breast wheel consumes about double the quantity of water that the overshot wheel does, to do the same quantity of work, when other things are alike, viz.: the diameter and breadth of the wheel, number of float-boards, etc., etc.

In order to permit any of the water-wheels to work with freedom, and to the greatest advantage, it is absolutely necessary that the tail-water, as it is called, or that which is discharged from the bottom of the wheel, after it has produced its effect, should have uninterrupted passage to run away; for when it accumulates, and forms a resistance to the float-boards, it must stop the velocity and power of the wheel; sometimes, indeed, to so great an extent as to prevent it from working altogether. The simplest and most effective mode of removing this great inconvenience is by forming two drains or tunnels through the masonry, one on each side of the

water-wheel, so as to permit a portion of water to flow down into the tail or lower stream, immediately in front of the wheel. Each of these drains is furnished with a sluice-gate at the upper end, by which the quantity of water can be regulated at pleasure, or the whole be shut off whenever water happens to be scarce. When the stream is high, these two gates can be drawn; the water drives the tail-water before it, and forms a basin or hollow space in which the wheel can work free from interruption. This applies to all kinds of wheels, when there is backwater to overcome.

Overshot or Breast Wheels.

The following table shows the required length of overshot or breast wheels, on falls from ten to thirty feet, to drive from one to four run of four and a half feet stones, with all the necessary machinery for a merchant flouring mill. The column marked "fall" shows the number of feet fall on the breast wheel, or the diameter of the overshot.

Diameter of overshot in fall.	Number of run of stones. 1. Length of wheel in feet.	2. Twice.	3. Three times.	4. Four times.
10	7			
11	6¼			
12	5¾			
13	5½			
14	5			
15	4½			
16	4¼			
17	4			
18	4			
19	3¾			
20	3½			
21	3¼			
22	3¼			
23	3			
24	3			
25	2¾			
26	2¾			
27	2½			
28	2½			
29	2½			
30	2¼			

Rule. — Multiply the number of runs required by the length, as stated in the table.

Example.—What should the length of either a breast or an overshot-wheel be, to drive 3 run of stones on a fall of 24 feet? Look at 24 feet, and opposite we have 3 feet for 1 run; which, multiplied by 3, gives 9 feet.

The same quantity of water used on the combination reaction wheel will suit the overshot and breast, beginning at 10 feet.

TABLE

Of the number of inches of water necessary to drive one run of stones, with all the requisite machinery for grist and saw mills, which will be found convenient for all practical purposes. Under heads of water from four to thirty feet.

Height of head in feet.	Size of stone in feet. 4	Size of stone in feet. 4½	Horse power.	Horse power.	Height of head in feet.	Size of stone in feet. 4	Size of stone in feet. 4½	Horse power.	Horse power.	Height of head in feet.	Size of stone in feet. 4	Size of stone in feet. 4½	Horse power.	Horse power.
4	460	558	5	6	13	80	95	5	6	22	35	43	5	6
5	300	363	"	"	14	70	83	"	"	23	32	39	"	"
6	250	311	"	"	15	62	75	"	"	24	30	37	"	"
7	200	245	"	"	16	57	68	"	"	25	29	35	"	"
8	160	190	"	"	17	51	62	"	"	26	27	32	"	"
9	130	163	"	"	18	47	57	"	"	27	26	31	"	"
10	112	137	"	"	19	44	52	"	"	28	24	29	"	"
11	102	122	"	"	20	41	48	"	"	29	23	28	"	"
12	89	107	"	"	21	37	45	"	"	30	22	26	"	"

NOTE.—A horse power is considered equal to 33,000 pounds raised one foot high. . . . . The same quantity of water that is here used for a four foot stone, is sufficient for one saw. And where a greater number of either saws or stones are required, you should double the quantity in proportion to the number, as in the case of four run of stones. You require four wheels, with the same number of inches, for each size, as per table. But, in all cases, for merchant flouring mills, you require an extra wheel, which all the machinery should be attached to, with about one half the power, as calculated for one run of four and a half feet stones

TABLE

Containing the weight of columns of water, each one foot in length, and of various diameters, in pounds Avoirdupois.

Diameter in inches.	Weight.	Diameter in inches.	Weight.	Diameter in inches.	Weight.	Diameter in inches.	Weight.	Diameter in inches.	Weight.
3	3.0672	11	41.2476	19	123.0624	27	248.5116	35	417.5952
4	5.4540	12	49.0884	20	136.3562	28	267.2616	36	441.7992
5	8.5212	13	57.6108	21	150.2376	29	286.6920	37	466.6990
6	12.2712	14	66.8148	22	164.9928	30	306.8052	38	492.2637
7	16.7028	15	76.7004	23	180.3324	31	327.6000	39	518.4132
8	21.8172	16	87.2688	24	196.3548	32	349.0764	40	545.4445
9	27.6120	17	98.5176	25	213.0598	33	371.2344	41	573.0577
10	34.0884	18	110.4492	26	230.4444	34	394.0740	50	799.2426

The Undershot Wheel.

The undershot wheel differs from all others in principle, as the water loses all its force by the first stroke against the floats, and the time this force is spending is in the proportion to the difference of the velocity of the wheel and the water, and the distance of the floats. As these wheels do not require much fall in the stream of water, all that is wanted is a rapid progressive motion in it; and as it acts chiefly by the momentum of the water, its positive weight being scarcely called into action, it is fit to be used where there is a profusion of water always in motion. The undershot-wheel does its maximum quantity of work when its circumference moves with between one

half and one third the velocity of the stream that drives it. Other wheels have the weight of the water after the force of the head is spent, and will continue to move; but an undershot wheel stops as soon as the head is spent. If the motion be too swift, the load or resistance it will overcome will be less, and the effects lessened also. The mill should, therefore, be so arranged in its machinery, that when the mill-stones run their proper speed, the water-wheel will not run too fast, as they will not then receive the full force of the water; nor too slow, so as to lose power by its rebounding and dashing over the floats.

The wheels, moving by the stroke of the water alone, are only half as powerful as other wheels that are moved by the stroke of water and its gravity combined. The undershot wheel ought, therefore, only to be used where there is but little fall and a great quantity of water. When the head of the water is great, if the gate is made of the usual form—that is, wide and shallow—the friction will be great. Therefore, the wheel should be narrow, and the aperture of the gate of a square form, in order to avoid the friction and loss in a wheel; especially if it does not run closely to the sheeting. The float-boards should be so constructed as to rise perpendicularly from the water; not more than one half of them should ever be below the surface, and from three to five should

be immersed at once, according to the magnitude of the wheel.

In adjusting the proportions of the internal wheels by which the machinery is propelled, it is necessary, in order to obtain the greatest power, to limit the speed of the rim of the water-wheel, so that it shall not be more than from four to five feet per second. The head should be from two to four feet above the aperture through which the water flows into the buckets, or against the floats of a water-wheel.

Tub Wheels.

The tub wheel is a horizontal water-wheel, that is acted on by the stroke of the water altogether. The shaft is perpendicular, often carrying the mill-stone on top of it, serving the place of a spindle. The lower end of this shaft is set in a step fixed in a bridge-tree, by which the stone is raised or lowered. The water is shot on to the upper side of the wheel, in the form of a tangent with its circumference. This wheel runs in a hoop similar to the hoop that is round the mill-stone, projecting so far above the wheel as to prevent the water from shooting over the wheel, and whirls it about until it strikes the buckets. As the water is shot on in a deep, narrow column—say ten inches wide and eighteen inches deep, with seven or

eight feet head for a four and a half feet pair of stones—the whole of this water cannot enter the buckets until a part has passed half way round the wheel, so that there are nearly half the buckets struck at once, The buckets are set obliquely, so that the water may strike them at right angles. As soon as it strikes, it escapes under the wheel in every direction. There should be one gate put on the outside of the penstock or shute, which should be drawn open that the shute of the water is full, and the quantity of water regulated by a gate inside of the shute, near the wheel, as the pressure of the whole weight of the head will then be on the wheel.

These wheels cannot be recommended, in consequence of the water not acting to advantage on them, even when constructed in the best possible manner. If the head be low, it is difficult to get a sufficient quantity of water to act on them, so as to drive them with sufficient power. There are some advantages in their first cost and simplicity, beside not having any cogs or rounds to keep in order; their moving parts are few, and have but little friction; the step-gudgeon runs under water, and, when fixed will not get out of order in a long time. The tub wheel should not be used where the water fails in dry weather; it is only suited to those streams where the water runs to waste the whole year; otherwise, they are useless in the season when they are most needed.

The Flutter Wheels.

The flutter wheels are mostly used for propelling the saw in saw mills, as their construction is very simple; in fact, one of the least expensive water-wheels that can be made. When the water is plenty, and the fall above six feet, flutter wheels may be used for saw mills; but should the water be scarce, and the head of water insufficient to give flutter-wheels the requisite motion, high wheels, double-geared, will be found necessary. Flutter wheels may be adapted to any head above six feet, by making them low and wide when the head is small, and high and narrow when there is a high head, so as to have from 120 to 130 revolutions or strokes of the saw per minute.

When the fall is about six feet, the diameter of the wheel should be about two feet eight inches, the width seven or eight feet; the greater the fall, the larger the diameter, with a smaller width. There should always be a full head, to give it a lively motion; otherwise, the mill will run heavy. The opening in the gates should be from three to four inches, that the water may give the required power. The wheel should have a sufficient quantity of buckets or floats; these are fastened on with keys, so that they will drive inward when any thing gets under them, and not break. These wheels require to be made heavy, to regulate the motion, and work more powerfully.

The Laws of Motion and Rest.

1. Every body in a state of rest will remain so. Every body in motion will continue to move in a right line, until a change is effected by the agency of some mechanical force.

2. The change from rest to motion, and from motion to rest, is always proportional to the force producing these changes.

3. Action and reaction are always equal, and in directions contrary to each other; or when two bodies act upon each other, the forces are always equal, and directed toward contrary parts.

4. A horizontal shaft, we will say eight feet in length, more or less, takes more power to drive a given weight, when this weight is attached to the farther end from the driving power, than if closer to said power. The retardition, in this case, is proportioned to the density of the air; and the rotary motion is the consequence of the force of gravity, which is always drawing it toward the earth.

Power of Gravity, Percussion, or Impulse, with the Reaction Attachment

It is admitted by mechanics that a water-wheel, constructed to receive the water, with this combination for driving machinery, is nearly as

effective as the overshot wheel; it is generally known that, if it were possible to gear the overshot wheel into the pinion that drives the mill-stone, it would have double the power of any other wheel, nearly. We know, without double-gearing, the motion would not be sufficient for the mill-stone; this is quite the reverse with the combination wheels. One of these wheels, about four feet in diameter, under a head of water twelve feet head and fall, will drive a run of stones four and a half feet in diameter, giving the stones a motion of 168 revolutions per minute; or it may give as many more as required, by altering the size of the wheel.

It is acknowledged by millwrights that a fluid reacts back against the penstock with the same force that it issues against the obstacle it strikes. Reaction water-wheels are of a numerous family, and of different degrees. I believe the Barkers wheel is one of the first. Scientific works acknowledge that action and reaction are equal, or that the power of water by reaction was equal to its effective power by gravity and percussion. Some of these wheels will run, when there is high water, by giving a larger run of water; or, in other words, a larger opening in the gate, as is properly termed a full gate.

Often the wheel will not start, the impulse from the head not being sufficient to create the slightest motion, the buckets of the wheel being immersed in back-water. By turning the wheel

a few feet, and helping it to clear itself sufficiently, and from the combination of percussion or impulse from the head, and reaction from the bottom, momentary, it will do the same amount of work, only using more water. The advantages of the combination wheel are, the durability, and amount of capital saved by the difference of cost between them and the overshot wheels. I believe the overshot wheel will cost one half more, counting the gearing up to the stone pinion, than the combination wheel. Beside, the combination wheel is more durable, being mostly made of iron. The manner in which the combination wheel is placed, protects it from frost.

It is a well known fact, that water-wheels that are made of cast-iron are a most essential improvement, inasmuch as the resistance from friction is one third less than wood, beside its durability; and where the wheels are protected by racks, placed in or near the flumes to keep out all obstructions, they will last a long time.

The chief objection to a common overshot wheel is its great size and formidable cost; to which may be added the loss of power consequent upon the friction of the gearing requisite for bringing up the speed of the prime mover to the velocity indispensable to most ordinary mechanical operations. These objections do not apply to this species of water power, as the machine requires or occupies but a small space in comparison with a water

wheel of the same power. Its speed is high, and the expense of its construction greatly inferior to that of any other effectual mechanism we are now acquainted with for deriving a rotary motion from a head of water.

Their great merit is their simplicity and durability; and where there is a plentiful supply of water, they are, in many cases, preferable to any other wheel. In back-water, they will undoubtedly operate better than any other. There will be no sensible loss from their wading, but only from the diminution of the effective head. In eight feet fall, for example, if there be four feet of back-water, the remaining four feet will produce nearly or quite the full effect.

These wheels may be applied either on a horizontal or vertical shaft, and either singly or in pairs, according to circumstances, as they are numerous. I will not include all of them; for a head of four feet, the area or orifice should never be permitted to fall short of three times the number of square inches which can be delivered by all the openings of the floats. The penstock or gateway should be sufficiently large to admit freely the same proportionate quantity of water through every part of its section; about three times of the orifice of the cistern-head and the wheel.

For a greater head, these openings should be proportionately increased, as a good many have made failures for not paying attention to these

principles. Whenever it is practicable, the limit which has been given should be exceeded; but never can be diminished without loss of power.

TABLE

Of the velocities of the combination reaction water-wheel per minute, from heads of from four to thirty feet, calculated at the maximum point of effect, or what is generally called the "working point;" being one third less than the greatest velocity for wheels of the following size.

	Diameter in feet and inches.												
	2	2½	3	3½	4	4½	5	5½	6	6½	7	7½	8
4	122	98	81	70	61	54	49	44	40	37	35	33	30
5	137	109	91	78	68	60	54	49	45	42	39	36	34
6	149	120	100	85	75	66	60	54	50	46	42	40	37
7	160	129	107	92	81	71	64	58	53	49	46	43	40
8	173	138	115	98	86	76	69	62	57	53	49	46	43
9	184	147	122	105	92	81	73	66	61	56	52	49	46
10	194	154	128	110	97	86	77	70	64	59	55	51	48
11	203	162	135	115	101	90	81	73	67	62	57	54	50
12	212	169	141	121	106	94	84	77	70	65	60	56	53
13	220	176	147	126	110	98	88	80	73	67	63	59	55
14	229	183	153	131	114	102	91	83	76	70	65	61	57
15	237	189	158	135	118	105	94	86	79	72	67	63	59
16	245	196	163	140	122	109	98	89	81	75	70	65	61
17	252	201	168	144	126	112	100	91	84	77	72	67	63
18	260	207	173	148	130	115	103	94	86	80	74	69	65
19	266	213	177	152	133	118	106	97	88	82	76	71	66
20	274	219	182	156	137	121	109	100	91	84	78	73	68
21	281	224	187	160	140	124	112	102	93	86	80	75	70
22	288	229	191	164	143	127	114	105	95	88	82	76	72
23	294	234	195	167	146	131	117	107	97	90	84	78	73
24	300	239	199	170	149	133	119	109	99	92	85	79	74
25	307	245	204	175	153	136	121	111	102	94	87	81	76
26	313	249	208	178	156	138	124	113	104	96	89	83	78
27	318	254	212	182	159	141	127	116	106	98	91	85	80
28	324	259	216	185	162	144	129	118	108	100	92	86	81
29	330	263	219	188	164	146	131	120	110	101	94	88	82
30	335	268	223	191	167	149	134	123	112	103	95	89	84

TABLE,

To reckon the Price of Wheat from Thirty Cents to Two Dollars per Bushel.

For the convenience of Millers I subjoin the following Tables. The Prices will be found at the top of the page, and in the columns headed "Value of Bushels" and "Value of Pounds," and directly opposite the number of Bushels and Pounds in the left hand column will be found the value—in Dollars, Cents and Mills—of one Bushel, or one Pound, up to one hundred Bushels, or one hundred Pounds.

No. of Bushels and Pounds.	AT 31 CENTS PER BUSHEL.		AT 32 CENTS PER BUSHEL.		AT 33 CENTS PER BUSHEL.		AT 34 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	31	5	32	5	33	5	34	5
2	62	1 0	64	1 0	66	1 1	68	1 1
3	93	1 5	96	1 6	99	1 6	1 02	1 7
4	1 24	2 0	1 28	2 1	1 32	2 2	1 36	2 2
5	1 55	2 5	1 60	2 6	1 65	2 7	1 70	2 8
6	1 86	3 1	1 92	3 2	1 98	3 3	2 04	3 4
7	2 17	3 6	2 24	3 7	2 31	3 8	2 38	3 9
8	2 48	4 1	2 56	4 2	2 64	4 4	2 72	4 5
9	2 79	4 6	2 88	4 8	2 97	4 9	3 06	5 1
10	3 10	5 1	3 20	5 3	3 30	5 5	3 40	5 6
11	3 41	5 6	3 52	5 8	3 63	6 0	3 74	6 2
12	3 72	6 2	3 84	6 4	3 96	6 6	4 08	6 8
13	4 03	6 7	4 16	6 9	4 29	7 1	4 42	7 3
14	4 34	7 2	4 48	7 4	4 62	7 7	4 76	7 9
15	4 65	7 7	4 80	8 0	4 95	8 2	5 10	8 5
16	4 96	8 2	5 12	8 5	5 28	8 8	5 44	9 0
17	5 27	8 7	5 44	9 0	5 61	9 3	5 78	9 6
18	5 58	9 3	5 76	9 6	5 94	9 9	6 12	10 2
19	5 89	9 8	6 08	10 1	6 27	10 4	6 46	10 7
20	6 20	10 3	6 40	10 6	6 60	11 0	6 80	11 3
21	6 51	10 8	6 72	11 2	6 93	11 5	7 14	11 9
22	6 82	11 3	7 04	11 7	7 26	12 1	7 48	12 4
23	7 13	11 8	7 36	12 2	7 59	12 6	7 82	13 0
24	7 44	12 4	7 68	12 8	7 92	13 2	8 16	13 6
25	7 75	12 9	8 00	13 3	8 25	13 7	8 50	14 1
26	8 06	13 4	8 32	13 8	8 58	14 3	8 84	14 7
27	8 37	13 9	8 64	14 4	8 91	14 8	9 18	15 3
28	8 68	14 4	8 96	14 9	9 24	15 4	9 52	15 8
29	8 99	14 9	9 28	15 4	9 57	15 9	9 86	16 4
30	9 30	15 5	9 60	16 0	9 90	16 5	10 20	17 0
40	12 40	20 6	12 80	21 3	13 20	22 0	13 60	22 6
50	15 50	25 8	16 00	26 6	16 50	27 5	17 00	28 3
100	31 00	51 6	32 00	53 3	33 00	55 0	34 00	56 6

No. of Bushels and Pounds.	AT 35 CENTS PER BUSHEL.		AT 36 CENTS PER BUSHEL.		AT 37 CENTS PER BUSHEL.		AT 38 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	35	5	36	6	37	6	38	6
2	70	1 1	72	1 2	74	1 2	76	1 2
3	1 05	1 7	1 08	1 8	1 11	1 8	1 14	1 9
4	1 40	2 3	1 44	2 4	1 48	2 4	1 52	2 5
5	1 75	2 9	1 80	3 0	1 85	3 0	1 90	3 1
6	2 10	3 5	2 16	3 6	2 22	3 7	2 28	3 8
7	2 45	4 0	2 52	4 2	2 59	4 3	2 66	4 4
8	2 80	4 6	2 88	4 8	2 96	4 9	3 04	5 0
9	3 15	5 2	3 24	5 4	3 33	5 5	3 42	5 7
10	3 50	5 8	3 60	6 0	3 70	6 1	3 80	6 3
11	3 85	6 4	3 96	6 6	4 07	6 7	4 18	6 9
12	4 20	7 0	4 32	7 2	4 44	7 4	4 56	7 6
13	4 55	7 5	4 68	7 8	4 81	8 0	4 94	8 2
14	4 90	8 1	5 04	8 4	5 18	8 6	5 32	8 8
15	5 25	8 7	5 40	9 0	5 55	9 2	5 70	9 5
16	5 60	9 3	5 76	9 6	5 92	9 8	6 08	10 1
17	5 95	9 9	6 12	10 2	6 29	10 4	6 46	10 7
18	6 30	10 5	6 48	10 8	6 66	11 1	6 84	11 4
19	6 65	11 0	6 84	11 4	7 03	11 7	7 22	12 0
20	7 00	11 6	7 20	12 0	7 40	12 3	7 60	12 6
21	7 35	12 2	7 56	12 6	7 77	12 9	7 98	13 3
22	7 70	12 8	7 92	13 2	8 14	13 5	8 36	13 9
23	8 05	13 4	8 28	13 8	8 51	14 1	8 74	14 5
24	8 40	14 0	8 64	14 4	8 88	14 8	9 12	15 2
25	8 75	14 5	9 00	15 0	9 25	15 4	9 50	15 8
26	9 10	15 1	9 36	15 6	9 62	16 0	9 88	16 4
27	9 45	15 7	9 72	16 2	9 99	16 6	10 26	17 1
28	9 80	16 3	10 08	16 8	10 36	17 2	10 64	17 7
29	10 15	16 9	10 44	17 4	10 73	17 8	11 02	18 3
30	10 50	17 5	10 80	18 0	11 10	18 5	11 40	19 0
40	14 00	23 3	14 40	24 0	14 80	24 6	15 20	25 3
50	17 50	29 1	18 00	30 0	18 50	30 8	19 00	31 6
100	35 00	58 3	36 00	60 0	37 00	61 6	38 00	63 3

No. of Bushels and Pounds.	AT 39 CENTS PER BUSHEL.		AT 40 CENTS PER BUSHEL.		AT 41 CENTS PER BUSHEL.		AT 42 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	39	6	40	6	41	6	42	7
2	78	1 3	80	1 3	82	1 3	84	1 4
3	1 17	1 9	1 20	2 0	1 23	2 0	1 26	2 1
4	1 56	2 6	1 60	2 6	1 64	2 7	1 68	2 8
5	1 95	3 2	2 00	3 3	2 05	3 4	2 10	3 5
6	2 34	3 9	2 40	4 0	2 46	4 1	2 52	4 2
7	2 73	4 5	2 80	4 6	2 87	4 7	2 94	4 9
8	3 12	5 2	3 20	5 3	3 28	5 4	3 36	5 6
9	3 51	5 8	3 60	6 0	3 69	6 1	3 78	6 3
10	3 90	6 5	4 00	6 6	4 10	6 8	4 20	7 0
11	4 29	7 1	4 40	7 3	4 51	7 5	4 62	7 7
12	4 68	7 8	4 80	8 0	4 92	8 2	5 04	8 4
13	5 07	8 4	5 20	8 6	5 33	8 8	5 46	9 1
14	5 46	9 1	5 60	9 3	5 74	9 5	5 88	9 8
15	5 85	9 7	6 00	10 0	6 15	10 2	6 30	10 5
16	6 24	10 4	6 40	10 6	6 56	10 9	6 72	11 2
17	6 63	11 0	6 80	11 3	6 97	11 6	7 14	11 9
18	7 02	11 7	7 20	12 0	7 38	12 3	7 56	12 6
19	7 41	12 3	7 60	12 6	7 79	12 9	7 98	13 3
20	7 80	13 0	8 00	13 3	8 20	13 6	8 40	14 0
21	8 19	13 6	8 40	14 0	8 61	14 3	8 82	14 7
22	8 58	14 3	8 80	14 6	9 02	15 0	9 24	15 4
23	8 97	14 9	9 20	15 3	9 43	15 7	9 66	16 1
24	9 36	15 6	9 60	16 0	9 84	16 4	10 08	16 8
25	9 75	16 2	10 00	16 6	10 25	17 0	10 50	17 5
26	10 14	16 9	10 40	17 3	10 66	17 7	10 92	18 2
27	10 53	17 5	10 80	18 0	11 07	18 4	11 34	18 9
28	10 92	18 2	11 20	18 6	11 48	19 1	11 76	19 6
29	11 31	18 8	11 60	19 3	11 89	19 8	12 18	20 3
30	11 70	19 5	12 00	20 0	12 30	20 5	12 60	21 0
40	15 60	26 0	16 00	26 6	16 40	27 3	16 80	28 0
50	19 50	32 5	20 00	33 3	20 50	34 1	21 00	35 0
100	39 00	65 0	40 00	66 6	41 00	68 3	42 00	70 0

No. of Bushels and Pounds.	AT 43 CENTS PER BUSHEL.		AT 44 CENTS PER BUSHEL.		AT 45 CENTS PER BUSHEL.		AT 46 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	43	7	44	7	45	7	46	7
2	86	1 4	88	1 4	90	1 5	92	1 5
3	1 29	2 1	1 32	2 2	1 35	2 2	1 38	2 3
4	1 72	2 8	1 76	2 9	1 80	3 0	1 84	3 0
5	2 15	3 5	2 20	3 6	2 25	3 7	2 30	3 8
6	2 58	4 3	2 64	4 4	2 70	4 5	2 76	4 6
7	3 01	5 0	3 08	5 1	3 15	5 2	3 22	5 3
8	3 44	5 7	3 52	5 8	3 60	6 0	3 68	6 1
9	3 87	6 4	3 96	6 6	4 05	6 7	4 14	6 9
10	4 30	7 1	4 40	7 3	4 50	7 5	4 60	7 6
11	4 73	7 8	4 84	8 0	4 95	8 2	5 06	8 4
12	5 16	8 6	5 28	8 8	5 40	9 0	5 52	9 2
13	5 59	9 3	5 72	9 5	5 85	9 7	5 98	9 9
14	6 02	10 0	6 16	10 2	6 30	10 5	6 44	10 7
15	6 45	10 7	6 60	11 0	6 75	11 2	6 90	11 5
16	6 88	11 4	7 04	11 7	7 20	12 0	7 36	12 2
17	7 31	12 1	7 48	12 4	7 65	12 7	7 82	13 0
18	7 74	12 9	7 92	13 2	8 10	13 5	8 28	13 8
19	8 17	13 6	8 36	13 9	8 55	14 2	8 74	14 5
20	8 60	14 3	8 80	14 6	9 00	15 0	9 20	15 3
21	9 03	15 0	9 24	15 4	9 45	15 7	9 66	16 1
22	9 46	15 7	9 60	16 1	9 90	16 5	10 12	16 8
23	9 89	16 5	10 12	16 8	10 35	17 2	10 58	17 6
24	10 32	17 2	10 56	17 6	10 80	18 0	11 04	18 4
25	10 75	17 9	11 00	18 3	11 25	18 7	11 50	19 1
26	11 18	18 6	11 44	19 0	11 70	19 5	11 96	19 9
27	11 61	19 3	11 88	19 8	12 15	20 2	12 42	20 7
28	12 04	20 0	12 32	20 5	12 60	21 0	12 88	21 4
29	12 47	20 7	12 76	21 2	13 05	21 7	13 34	22 2
30	12 90	21 5	13 20	22 0	13 50	22 5	13 80	23 0
40	17 20	28 6	17 60	29 3	18 00	30 0	18 40	30 6
50	21 50	35 8	22 00	36 6	22 50	37 5	23 00	38 3
100	43 00	71 6	44 00	73 3	45 00	75 0	46 00	76 6

No. of Bushels and Pounds.	AT 47 CENTS PER BUSHEL.		AT 48 CENTS PER BUSHEL.		AT 49 CENTS PER BUSHEL.		AT 50 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	47	7	48	8	49	8	50	8
2	94	1 5	96	1 6	98	1 6	1 00	1 6
3	1 41	2 3	1 44	2 4	1 47	2 4	1 50	2 5
4	1 88	3 1	1 92	3 2	1 96	3 2	2 00	3 3
5	2 35	3 9	2 40	4 0	2 45	4 0	2 50	4 1
6	2 82	4 7	2 88	4 8	2 94	4 9	3 00	5 0
7	3 29	5 4	3 36	5 6	3 43	5 7	3 50	5 8
8	3 76	6 2	3 84	6 4	3 92	6 5	4 00	6 6
9	4 23	7 0	4 32	7 2	4 41	7 3	4 50	7 5
10	4 70	7 8	4 80	8 0	4 90	8 1	5 00	8 3
11	5 17	8 6	5 28	8 8	5 39	8 9	5 50	9 1
12	5 64	9 4	5 76	9 6	5 88	9 8	6 00	10 0
13	6 11	10 1	6 24	10 4	6 37	10 6	6 50	10 8
14	6 58	10 9	6 72	11 2	6 86	11 4	7 00	11 6
15	7 05	11 7	7 20	12 0	7 35	12 2	7 50	12 5
16	7 52	12 5	7 68	12 8	7 84	13 0	8 00	13 3
17	7 99	13 3	8 16	13 6	8 33	13 8	8 50	14 1
18	8 46	14 1	8 64	14 4	8 82	14 7	9 00	15 0
19	8 93	14 8	9 12	15 2	9 31	15 5	9 50	15 8
20	9 40	15 6	9 60	16 0	9 80	16 3	10 00	16 6
21	9 87	16 4	10 08	16 8	10 29	17 1	10 50	17 5
22	10 34	17 2	10 56	17 6	10 78	17 9	11 00	18 3
23	10 81	18 0	11 04	18 4	11 27	18 7	11 50	19 1
24	11 28	18 8	11 52	19 2	11 76	19 6	12 00	20 0
25	11 75	19 5	12 00	20 0	12 25	20 4	12 50	20 8
26	12 22	20 3	12 48	20 8	12 74	21 2	13 00	21 6
27	12 69	21 1	12 96	21 6	13 23	22 0	13 50	22 5
28	13 16	21 9	13 44	22 4	13 72	22 8	14 00	23 3
29	13 63	22 7	13 92	23 2	14 21	23 6	14 50	24 1
30	14 10	23 5	14 40	24 0	14 70	24 5	15 00	25 0
40	18 80	31 3	19 20	32 0	19 60	32 6	20 00	33 3
50	23 50	39 1	24 00	40 0	24 50	40 8	25 00	41 6
100	47 00	78 3	48 00	80 0	49 00	81 6	50 00	83 3

No. of Bushels and Pounds.	AT 51 CENTS PER BUSHEL.		AT 52 CENTS PER BUSHEL.		AT 53 CENTS PER BUSHEL.		AT 54 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	51	8	52	8	53	8	54	9
2	1 02	1 7	1 04	1 7	1 06	1 7	1 08	1 8
3	1 53	2 5	1 56	2 6	1 59	2 6	1 62	2 7
4	2 04	3 4	2 08	3 4	2 12	3 5	2 16	3 6
5	2 55	4 2	2 60	4 3	2 65	4 4	2 70	4 5
6	3 06	5 1	3 12	5 2	3 18	5 3	3 24	5 4
7	3 57	5 9	3 64	6 0	3 71	6 1	3 78	6 3
8	4 08	6 8	4 16	6 9	4 24	7 0	4 32	7 2
9	4 59	7 6	4 68	7 8	4 77	7 9	4 86	8 1
10	5 10	8 5	5 20	8 6	5 30	8 8	5 40	9 0
11	5 61	9 3	5 72	9 5	5 83	9 7	5 94	9 9
12	6 12	10 2	6 24	10 4	6 36	10 6	6 48	10 8
13	6 63	11 0	6 76	11 2	6 89	11 4	7 02	11 7
14	7 14	11 9	7 28	12 1	7 42	12 4	7 56	12 6
15	7 65	12 7	7 80	13 0	7 95	13 2	8 10	13 5
16	8 16	13 6	8 32	13 8	8 48	14 1	8 64	14 4
17	8 67	14 4	8 84	14 7	9 01	15 0	9 18	15 3
18	9 18	15 3	9 36	15 6	9 54	15 9	9 72	16 2
19	9 69	16 1	9 88	16 4	10 07	16 7	10 26	17 1
20	10 20	17 0	10 40	17 3	10 60	17 6	10 80	18 0
21	10 71	17 8	10 92	18 2	11 13	18 5	11 34	18 9
22	11 22	18 7	11 44	19 0	11 66	19 4	11 88	19 8
23	11 73	19 5	11 96	19 9	12 19	20 3	12 42	20 7
24	12 24	20 4	12 48	20 8	12 72	21 2	12 96	21 6
25	12 75	21 2	13 00	21 6	13 25	22 0	13 50	22 5
26	13 26	22 1	13 52	22 5	13 78	22 9	14 04	23 4
27	13 77	22 9	14 04	23 4	14 31	23 8	14 58	24 3
28	14 28	23 8	14 56	24 2	14 84	24 7	15 12	25 2
29	14 79	24 6	15 08	25 1	15 37	25 6	15 66	26 1
30	15 30	25 5	15 60	26 0	15 90	26 5	16 20	27 0
40	20 40	34 0	20 80	34 6	21 20	35 3	21 60	36 0
50	25 50	42 5	26 00	43 3	26 50	44 1	27 00	45 0
100	51 00	85 0	52 00	86 6	53 00	88 3	54 00	90 0

No. of Bushels and Pounds.	AT 55 CENTS PER BUSHEL.		AT 56 CENTS PER BUSHEL.		AT 57 CENTS PER BUSHEL.		AT 58 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	55	9	56	9	57	9	58	9
2	1 10	1 8	1 12	1 8	1 14	1 9	1 16	1 9
3	1 65	2 7	1 68	2 8	1 71	2 8	1 74	2 9
4	2 20	3 6	2 24	3 7	2 28	3 8	2 32	3 8
5	2 75	4 5	2 80	4 6	2 85	4 7	2 90	4 8
6	3 30	5 5	3 36	5 6	3 42	5 7	3 48	5 8
7	3 85	6 4	3 92	6 5	3 99	6 6	4 06	6 7
8	4 40	7 3	4 48	7 4	4 56	7 6	4 64	7 7
9	4 95	8 2	5 04	8 4	5 13	8 5	5 22	8 7
10	5 50	9 1	5 60	9 3	5 70	9 5	5 80	9 6
11	6 05	10 0	6 16	10 2	6 27	10 4	6 38	10 6
12	6 60	11 0	6 72	11 2	6 84	11 4	6 96	11 6
13	7 15	11 9	7 28	12 1	7 41	12 3	7 54	12 5
14	7 70	12 9	7 84	13 0	7 98	13 3	8 12	13 5
15	8 25	13 7	8 40	14 0	8 55	14 2	8 70	14 5
16	8 80	14 6	8 96	14 9	9 12	15 2	9 28	15 4
17	9 35	15 5	9 52	15 8	9 69	16 1	9 86	16 4
18	9 90	16 5	10 08	16 8	10 26	17 1	10 44	17 4
19	10 45	17 4	10 64	17 7	10 83	18 0	11 02	18 3
20	11 00	18 3	11 20	18 6	11 40	19 0	11 60	19 3
21	11 55	19 2	11 76	19 6	11 97	19 9	12 18	20 3
22	12 10	20 1	12 32	20 5	12 54	20 9	12 76	21 2
23	12 65	21 0	12 88	21 4	13 11	21 8	13 34	22 2
24	13 20	22 0	13 44	22 4	13 68	22 8	13 92	23 2
25	13 75	22 9	14 00	23 3	14 25	23 7	14 50	24 1
26	14 30	23 8	14 56	24 2	14 82	24 7	15 08	25 1
27	14 85	24 7	15 12	25 2	15 39	25 6	15 66	26 1
28	15 40	25 6	15 68	26 1	15 96	26 6	16 24	27 0
29	15 95	26 5	16 24	27 0	16 53	27 5	16 82	28 0
30	16 50	27 5	16 80	28 0	17 10	28 5	17 40	29 0
40	22 00	36 6	22 40	37 3	22 80	38 0	23 20	38 6
50	27 50	45 8	28 00	46 6	28 50	47 5	29 00	48 3
100	55 00	91 6	56 00	93 3	57 00	95 0	58 00	96 6

No. of Bushels and Pounds.	AT 59 CENTS PER BUSHEL.		AT 60 CENTS PER BUSHEL.		AT 61 CENTS PER BUSHEL.		AT 62 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	59	9	60	1 0	61	1 0	62	1 0
2	1 18	1 9	1 20	2 0	1 22	2 0	1 24	2 0
3	1 77	2 9	1 80	3 0	1 83	3 0	1 86	3 1
4	2 36	3 9	2 40	4 0	2 44	4 0	2 48	4 1
5	2 95	4 9	3 00	5 0	3 05	5 0	3 10	5 0
6	3 54	5 9	3 60	6 0	3 66	6 1	3 72	6 2
7	4 13	6 8	4 20	7 0	4 27	7 1	4 34	7 2
8	4 72	7 8	4 80	8 0	4 88	8 1	4 96	8 2
9	5 31	8 8	5 40	9 0	5 49	9 1	5 58	9 3
10	5 90	9 8	6 00	10 0	6 10	10 1	6 20	10 3
11	6 49	10 8	6 60	11 0	6 71	11 1	6 82	11 3
12	7 08	11 8	7 20	12 0	7 32	12 2	7 44	12 4
13	7 67	12 7	7 80	13 0	7 93	13 2	8 06	13 4
14	8 26	13 7	8 40	14 0	8 54	14 2	8 68	14 4
15	8 85	14 7	9 00	15 0	9 15	15 2	9 30	15 5
16	9 44	15 7	9 60	16 0	9 76	16 2	9 92	16 5
17	10 03	16 7	10 20	17 0	10 37	17 2	10 54	17 5
18	10 62	17 7	10 80	18 0	10 98	18 3	11 16	18 6
19	11 21	18 6	11 40	19 0	11 59	19 3	11 78	19 6
20	11 80	19 6	12 00	20 0	12 20	20 3	12 40	20 6
21	12 39	20 6	12 60	21 0	12 81	21 3	13 02	21 7
22	12 98	21 6	13 20	22 0	13 42	22 3	13 64	22 7
23	13 57	22 6	13 80	23 0	14 03	23 4	14 26	23 7
24	14 16	23 6	14 40	24 0	14 64	24 4	14 88	24 8
25	14 75	24 5	15 00	25 0	15 25	25 4	15 50	25 8
26	15 34	25 5	15 60	26 0	15 86	26 4	16 12	26 8
27	15 93	26 5	16 20	27 0	16 47	27 4	16 74	27 9
28	16 52	27 5	16 80	28 0	17 08	28 4	17 36	28 9
29	17 11	28 5	17 40	29 0	17 69	29 4	17 98	29 9
30	17 70	29 5	18 00	30 0	18 30	30 5	18 60	31 0
40	23 60	39 3	24 00	40 0	24 40	40 6	24 80	41 3
50	29 50	49 1	30 00	50 0	30 50	50 8	31 00	51 6
100	59 00	98 3	60 00	100 0	61 00	101 6	62 00	103 3

No. of Bushels and Pounds.	AT 63 CENTS PER BUSHEL		AT 64 CENTS PER BUSHEL.		AT 65 CENTS PER BUSHEL.		AT 66 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	63	1 0	64	1 0	65	1 0	66	1 1
2	1 26	2 1	1 28	2 1	1 30	2 1	1 32	2 2
3	1 89	3 1	1 92	3 2	1 95	3 2	1 98	3 3
4	2 52	4 2	2 56	4 2	2 60	4 3	2 64	4 4
5	3 15	5 2	3 20	5 3	3 25	5 4	3 30	5 5
6	3 78	6 3	3 84	6 4	3 90	6 5	3 96	6 6
7	4 41	7 3	4 48	7 4	4 55	7 5	4 62	7 7
8	5 04	8 4	5 12	8 5	5 20	8 6	5 28	8 8
9	5 67	9 4	5 76	9 6	5 85	9 7	5 94	9 9
10	6 30	10 5	6 40	10 6	6 50	10 8	6 60	11 0
11	6 93	11 5	7 04	11 7	7 15	11 9	7 26	12 1
12	7 56	12 6	7 68	12 8	7 80	13 0	7 92	13 2
13	8 19	13 6	8 32	13 8	8 45	14 0	8 58	14 3
14	8 82	14 7	8 96	14 9	9 10	15 1	9 24	15 4
15	9 94	15 7	9 60	16 0	9 75	16 2	9 90	16 5
16	10 08	16 8	10 24	17 0	10 40	17 3	10 56	17 6
17	10 71	17 8	10 88	18 1	11 05	18 4	11 22	18 7
18	11 34	18 9	11 52	19 2	11 70	19 5	11 88	19 8
19	11 97	19 9	12 16	20 2	12 35	20 5	12 54	20 9
20	12 60	21 0	12 80	21 3	13 00	21 6	13 20	22 0
21	13 23	22 0	13 44	22 4	13 65	22 7	13 86	23 1
22	13 86	23 1	14 08	23 4	14 30	23 8	14 52	24 2
23	14 49	24 2	14 72	24 5	14 95	24 9	15 18	25 3
24	15 12	25 2	15 36	25 6	15 60	26 0	15 84	26 4
25	15 75	26 2	16 00	26 6	16 25	27 0	16 50	27 5
26	16 38	27 3	16 64	27 7	16 90	28 1	17 16	28 6
27	17 01	28 3	17 28	28 8	17 55	29 2	17 82	29 7
28	17 64	29 4	17 92	29 8	18 20	30 3	18 48	30 8
29	18 27	30 4	18 56	30 9	18 85	31 4	19 14	31 9
30	18 90	31 5	19 20	32 0	19 50	32 5	19 80	33 0
40	25 20	42 0	25 60	42 6	26 00	43 3	26 40	44 0
50	31 50	52 5	32 00	53 3	32 50	54 1	33 00	55 0
100	63 00	105 0	64 00	106 6	65 00	108 3	66 00	110 0

No. of Bushels and Pounds.	AT 67 CENTS PER BUSHEL.		AT 68 CENTS PER BUSHEL.		AT 69 CENTS PER BUSHEL.		AT 70 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	67	1 1	68	1 1	69	1 1	70	1 1
2	1 34	2 2	1 36	2 2	1 38	2 3	1 40	2 3
3	2 01	3 3	2 04	3 4	2 07	3 4	2 10	3 5
4	2 68	4 4	2 72	4 5	2 76	4 6	2 80	4 6
5	3 35	5 5	3 40	5 6	3 45	5 7	3 50	5 8
6	4 02	6 7	4 08	6 8	4 14	6 9	4 20	7 0
7	4 69	7 8	4 76	7 9	4 83	8 0	4 90	8 1
8	5 36	8 9	5 44	9 0	5 52	9 2	5 60	9 3
9	6 03	10 0	6 12	10 2	6 21	10 3	6 30	10 5
10	6 70	11 1	6 80	11 3	6 90	11 5	7 00	11 6
11	7 37	12 2	7 48	12 4	7 59	12 6	7 70	12 8
12	8 04	13 4	8 16	13 6	8 28	13 8	8 40	14 0
13	8 71	14 5	8 84	14 7	8 97	14 9	9 10	15 1
14	9 38	15 6	9 52	15 8	9 66	16 1	9 80	16 3
15	10 05	16 7	10 20	17 0	10 35	17 2	10 50	17 5
16	10 72	17 8	10 88	18 1	11 04	18 4	11 20	18 6
17	11 39	18 9	11 56	19 2	11 73	19 5	11 90	19 8
18	12 06	20 1	12 24	20 4	12 42	20 7	12 60	21 0
19	12 73	21 2	12 92	21 5	13 11	21 8	13 30	22 1
20	13 40	22 3	13 60	22 6	13 80	23 0	14 00	23 3
21	14 07	23 4	14 28	23 8	14 49	24 1	14 70	24 5
22	14 74	24 5	14 96	24 9	15 18	25 3	15 40	25 6
23	15 41	25 6	15 64	26 0	15 87	26 4	16 10	26 8
24	16 08	26 8	16 32	27 2	16 56	27 6	16 80	28 0
25	16 75	27 9	17 00	28 3	17 25	28 7	17 50	29 1
26	17 42	29 0	17 68	29 5	17 94	29 8	18 20	30 3
27	18 09	30 1	18 36	30 6	18 63	31 0	18 90	31 5
28	18 76	31 2	19 04	31 7	19 32	32 2	19 60	32 6
29	19 43	32 3	19 72	32 9	20 01	33 3	20 30	33 8
30	20 10	33 5	20 40	34 0	20 70	34 5	21 00	35 0
40	26 80	44 6	27 20	45 3	27 60	46 0	28 00	46 6
50	33 50	55 8	34 00	56 6	34 50	57 3	35 00	58 3
100	67 00	111 6	68 00	113 3	69 00	115 0	70 00	116 6

No. of Bushels and Pounds.	AT 71 CENTS PER BUSHEL.		AT 72 CENTS PER BUSHEL.		AT 73 CENTS PER BUSHEL.		AT 74 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	71	1 1	72	1 2	73	1 2	74	1 2
2	1 42	2 3	1 44	2 4	1 46	2 4	1 48	2 4
3	2 13	3 5	2 16	3 6	2 19	3 6	2 22	3 7
4	2 84	4 7	2 88	4 8	2 92	4 8	2 96	4 9
5	3 55	5 9	3 60	6 0	3 65	6 0	3 70	6 1
6	4 26	7 1	4 32	7 2	4 38	7 3	4 44	7 4
7	4 97	8 2	5 04	8 4	5 11	8 5	5 18	8 6
8	5 68	9 4	5 76	9 6	5 84	9 7	5 92	9 8
9	6 39	10 6	6 48	10 8	6 57	10 9	6 66	11 1
10	7 10	11 8	7 20	12 0	7 30	12 1	7 40	12 3
11	7 81	13 0	7 92	13 2	8 03	13 3	8 14	13 5
12	8 52	14 2	8 64	14 4	8 76	14 6	8 88	14 8
13	9 23	15 3	9 36	15 6	9 49	15 8	9 62	16 0
14	9 94	16 5	10 08	16 8	10 22	17 0	10 36	17 2
15	10 65	17 7	10 80	18 0	10 95	18 2	11 10	18 5
16	11 36	18 9	11 52	19 2	11 68	19 4	11 84	19 7
17	12 07	20 1	12 24	20 4	12 41	20 8	12 58	20 9
18	12 78	21 3	12 96	21 6	13 14	21 9	13 32	22 2
19	13 49	22 4	13 68	22 8	13 87	23 1	14 06	23 4
20	14 20	23 6	14 40	24 0	14 60	24 3	14 80	24 6
21	14 91	24 8	15 12	25 2	15 33	25 5	15 54	25 9
22	15 62	26 0	15 84	26 4	16 06	26 7	16 28	27 1
23	16 33	27 2	16 56	27 6	16 79	27 9	17 02	28 3
24	17 04	28 4	17 28	28 8	17 52	29 2	17 76	29 6
25	17 75	29 5	18 00	30 0	18 25	30 4	18 50	30 8
26	18 46	30 7	18 72	31 2	18 98	31 6	19 24	32 0
27	19 17	31 9	19 44	32 4	19 71	32 8	19 98	33 3
28	19 88	33 1	20 16	33 6	20 44	34 0	20 72	34 5
29	20 59	34 3	20 88	34 8	21 17	35 2	21 46	35 7
30	21 30	35 5	21 60	36 0	21 90	36 5	22 20	37 0
40	28 40	47 3	28 80	48 0	29 20	48 6	29 60	49 3
50	35 50	59 1	36 00	60 0	36 50	60 8	37 00	61 6
100	71 00	118 3	72 00	120 0	73 00	121 6	74 00	123 3

No. of Bushels and Pounds.	AT 75 CENTS PER BUSHEL.		AT 76 CENTS PER BUSHEL.		AT 77 CENTS PER BUSHEL		AT 78 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	75	1 2	76	1 2	77	1 2	78	1 3
2	1 50	2 5	1 52	2 5	1 54	2 5	1 56	2 6
3	2 25	3 7	2 28	3 8	2 31	3 8	2 34	3 9
4	3 00	5 0	3 04	5 0	3 08	5 1	3 12	5 2
5	3 75	6 2	3 80	6 3	3 85	6 4	3 90	6 5
6	4 50	7 5	4 56	7 6	4 62	7 7	4 68	7 8
7	5 25	8 7	5 32	8 8	5 39	8 9	5 46	9 1
8	6 00	10 0	6 08	10 1	6 16	10 2	6 24	10 4
9	6 75	11 2	6 84	11 4	6 93	11 5	7 02	11 7
10	7 50	12 5	7 60	12 6	7 70	12 8	7 80	13 0
11	8 25	13 7	8 36	13 9	8 47	14 1	8 58	14 3
12	9 00	15 0	9 12	15 2	9 24	15 4	9 36	15 6
13	9 75	16 2	9 88	16 4	10 01	16 6	10 14	16 9
14	10 50	17 5	10 64	17 7	10 78	17 9	10 92	18 2
15	11 25	18 7	11 40	19 0	11 55	19 2	11 70	19 5
16	12 00	20 0	12 16	20 2	12 32	20 5	12 48	20 8
17	12 75	21 2	12 92	21 5	13 09	21 8	13 26	22 1
18	13 50	22 5	13 68	22 8	13 86	23 1	14 04	23 4
19	14 25	23 7	14 44	24 0	14 63	24 3	14 82	24 7
20	15 00	25 0	15 20	25 3	15 40	25 6	15 60	26 0
21	15 75	26 2	15 96	26 6	16 17	26 9	16 38	27 3
22	16 50	27 5	16 72	27 8	16 94	28 2	17 16	28 6
23	17 25	28 7	17 48	29 1	17 71	29 5	17 94	29 9
24	18 00	30 0	18 24	30 4	18 48	30 8	18 72	31 2
25	18 75	31 2	19 00	31 6	19 25	32 0	19 50	32 5
26	19 50	32 5	19 76	32 9	20 02	33 3	20 28	33 8
27	20 25	33 7	20 52	34 2	20 79	34 6	21 06	35 1
28	21 00	35 0	21 28	35 4	21 56	35 9	21 84	36 4
29	21 75	36 2	22 04	36 7	22 33	37 2	22 62	37 7
30	22 50	37 5	22 80	38 0	23 10	38 5	23 40	39 0
40	30 00	50 0	30 40	50 6	30 80	51 3	31 20	52 0
50	37 50	62 5	38 00	63 3	38 50	64 1	39 00	65 0
100	75 00	125 0	76 00	126 6	77 00	128 3	78 00	130 0

No. of Bushels and Pounds.	AT 79 CENTS PER BUSHEL		AT 80 CENTS PER BUSHEL.		AT 81 CENTS PER BUSHEL.		AT 82 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	79	1 3	80	1 3	81	1 3	82	1 3
2	1 58	2 6	1 60	2 6	1 62	2 7	1 64	2 7
3	2 37	3 9	2 40	4 0	2 43	4 0	2 46	4 1
4	3 16	5 2	3 20	5 3	3 24	5 4	3 28	5 4
5	3 95	6 5	4 00	6 6	4 05	6 7	4 10	6 8
6	4 74	7 9	4 80	8 0	4 86	8 1	4 92	8 2
7	5 53	9 2	5 60	9 3	5 67	9 4	5 74	9 5
8	6 32	10 5	6 40	10 6	6 48	10 8	6 56	10 9
9	7 11	11 8	7 20	12 0	7 29	12 1	7 38	12 3
10	7 90	13 1	8 00	13 3	8 10	13 5	8 20	13 6
11	8 69	14 4	8 80	14 6	8 91	14 8	9 02	15 0
12	9 48	15 8	9 60	16 0	9 72	16 2	9 84	16 4
13	10 27	17 1	10 40	17 3	10 53	17 5	10 66	17 7
14	11 06	18 4	11 20	18 6	11 34	18 9	11 48	19 1
15	11 85	19 7	12 00	20 0	12 15	20 2	12 30	20 5
16	12 64	21 0	12 80	21 3	12 96	21 6	13 12	21 8
17	13 43	22 3	13 60	22 6	13 77	22 9	13 94	23 2
18	14 22	23 7	14 40	24 0	14 58	24 3	14 76	24 6
19	15 01	25 0	15 20	25 3	15 39	25 6	15 58	25 9
20	15 80	26 3	16 00	26 6	16 20	27 0	16 40	23 3
21	16 59	27 6	16 80	28 0	17 01	28 3	17 22	28 7
22	17 38	28 9	17 60	29 3	17 82	29 7	18 04	30 0
23	18 17	30 2	18 40	30 6	18 63	31 0	18 86	31 4
24	18 96	31 6	19 20	32 0	19 44	32 4	19 68	32 8
25	19 75	32 9	20 00	33 3	20 25	33 4	20 50	34 1
26	20 54	34 2	20 80	34 6	21 06	35 1	21 32	35 5
27	21 33	35 5	21 60	36 0	21 87	36 4	22 14	36 9
28	22 12	36 8	22 40	37 3	22 68	37 8	22 96	38 2
29	22 91	38 1	23 20	38 6	23 49	39 1	23 78	39 6
30	23 70	39 5	24 00	40 0	24 30	40 5	24 60	41 0
40	31 60	52 6	32 00	53 3	32 40	54 0	32 80	54 6
50	39 50	65 8	40 00	66 6	40 50	67 5	41 00	68 3
100	79 00	131 6	80 00	133 3	81 00	135 0	82 00	136 6

No. of Bushels and Pounds.	AT 83 CENTS PER BUSHEL.		AT 84 CENTS PER BUSHEL.		AT 85 CENTS PER BUSHEL.		AT 86 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	83	1 3	84	1 4	85	1 4	86	1 4
2	1 66	2 7	1 68	2 8	1 70	2 8	1 72	2 8
3	2 49	4 1	2 52	4 2	2 55	4 2	2 58	4 3
4	3 32	5 5	3 36	5 6	3 40	5 6	3 44	5 7
5	4 15	6 9	4 20	7 0	4 25	7 0	4 30	7 1
6	4 98	8 3	5 04	8 4	5 10	8 5	5 16	8 6
7	5 81	9 6	5 88	9 8	5 95	9 9	6 02	10 0
8	6 64	11 0	6 72	11 2	6 80	11 3	6 88	11 4
9	7 47	12 4	7 56	12 6	7 65	12 7	7 74	12 9
10	8 30	13 8	8 40	14 0	8 50	14 1	8 60	14 3
11	9 13	15 2	9 24	15 4	9 35	15 5	9 46	15 7
12	9 96	16 6	10 08	16 8	10 20	17 0	10 32	17 2
13	10 79	17 9	10 92	18 2	11 05	18 4	11 18	18 6
14	11 62	19 3	11 76	19 6	11 90	19 8	12 04	20 0
15	12 45	20 7	12 60	21 0	12 75	21 2	12 90	21 5
16	13 28	22 1	13 44	22 4	13 60	22 6	13 76	22 9
17	14 11	23 6	14 28	23 8	14 45	24 0	14 62	24 3
18	14 94	24 9	15 12	25 2	15 30	25 5	15 48	25 8
19	15 77	26 2	15 96	26 6	16 15	26 9	16 34	27 2
20	16 60	27 6	16 80	28 0	17 00	28 3	17 20	28 6
21	17 43	29 0	17 64	29 4	17 85	29 7	18 06	30 1
22	18 26	30 4	18 48	30 8	18 70	31 1	18 92	31 5
23	19 09	31 8	19 32	32 2	19 55	32 5	19 78	32 9
24	19 92	33 2	20 16	33 6	20 40	34 0	20 64	34 4
25	20 75	34 5	21 00	35 0	21 25	35 4	21 50	35 8
26	21 58	35 9	21 84	36 4	22 10	36 8	22 36	37 2
27	22 41	37 3	22 68	37 8	22 95	38 2	23 22	38 7
28	23 24	38 7	23 52	39 2	23 80	39 6	24 08	40 1
29	24 07	40 1	24 36	40 6	24 65	41 0	24 94	41 5
30	24 90	41 5	25 20	42 0	25 50	42 5	25 88	43 1
40	33 20	55 3	33 60	56 0	34 00	56 6	34 40	57 3
50	41 50	69 1	42 00	70 0	42 50	70 8	43 00	71 6
100	83 00	138 3	84 00	140 0	85 00	141 6	86 00	143 3

No. of Bushels and Pounds.	AT 87 CENTS PER BUSHEL.		AT 88 CENTS PER BUSHEL.		AT 89 CENTS PER BUSHEL.		AT 90 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	87	1 4	88	1 4	89	1 4	90	1 5
2	1 74	2 9	1 76	2 9	1 78	2 9	1 80	3 0
3	2 61	4 3	2 64	4 4	2 67	4 4	2 70	4 5
4	3 48	5 8	3 52	5 8	3 56	5 9	3 60	6 0
5	4 35	7 2	4 40	7 3	4 45	7 4	4 50	7 5
6	5 22	8 7	5 28	8 8	5 34	8 9	5 40	9 0
7	6 09	10 1	6 16	10 2	6 23	10 3	6 30	10 5
8	6 96	11 6	7 04	11 7	7 12	11 8	7 20	12 0
9	7 83	13 0	7 92	13 2	8 01	13 3	8 10	13 5
10	8 70	14 5	8 80	14 6	8 90	14 8	9 00	15 0
11	9 57	15 9	9 68	16 1	9 79	16 3	9 90	16 5
12	10 44	17 4	10 56	17 6	10 68	17 8	10 80	18 0
13	11 31	18 8	11 44	19 0	11 57	19 2	11 70	19 5
14	12 18	20 3	12 32	20 5	12 46	20 7	12 60	21 0
15	13 05	21 7	13 20	22 0	13 35	22 2	13 50	22 5
16	13 92	23 2	14 08	23 4	14 24	23 7	14 40	24 0
17	14 79	24 6	14 96	24 9	15 13	25 2	15 30	25 5
18	15 66	26 1	15 84	26 4	16 02	26 7	16 20	27 0
19	16 53	27 5	16 72	27 8	16 91	28 1	17 10	28 5
20	17 40	29 0	17 60	29 3	17 80	29 6	18 00	30 0
21	18 27	30 6	18 48	30 8	18 69	31 1	18 90	31 5
22	19 14	31 9	19 36	32 2	19 58	32 6	19 80	33 0
23	20 01	33 3	20 24	33 7	20 47	34 1	20 70	34 5
24	20 88	34 8	21 12	35 2	21 36	35 6	21 60	36 0
25	21 75	36 2	22 00	36 6	22 25	37 0	22 50	37 5
26	22 62	37 7	22 88	38 1	23 14	38 5	23 40	39 0
27	23 49	39 1	23 76	39 6	24 03	40 0	24 30	40 5
28	24 36	40 6	24 64	41 0	24 92	41 5	25 20	42 0
29	25 23	42 0	25 52	42 5	25 81	43 0	26 10	43 5
30	26 10	43 5	26 40	44 0	26 70	44 5	27 00	45 0
40	34 80	58 0	35 20	58 6	35 60	59 3	36 00	60 0
50	43 50	72 5	44 00	73 3	44 50	74 1	45 00	75 0
100	87 00	145 0	88 00	146 6	89 00	148 3	90 00	150 0

No. of Bushels and Pounds.	AT 91 CENTS PER BUSHEL.		AT 92 CENTS PER BUSHEL.		AT 93 CENTS PER BUSHEL.		AT 94 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	91	1 5	92	1 5	93	1 5	94	1 5
2	1 82	3 0	1 84	3 0	1 86	3 1	1 88	3 1
3	2 73	4 5	2 76	4 6	2 79	4 6	2 82	4 7
4	3 64	6 0	3 68	6 1	3 72	6 2	3 76	6 2
5	4 55	7 5	4 60	7 6	4 65	7 7	4 70	7 8
6	5 46	9 1	5 52	9 2	5 58	9 3	5 64	9 4
7	6 37	10 6	6 44	10 7	6 51	10 8	6 58	10 9
8	7 28	12 1	7 36	12 2	7 44	12 4	7 52	12 5
9	8 19	13 6	8 28	13 8	8 37	13 9	8 46	14 1
10	9 10	15 1	9 20	15 3	9 30	15 5	9 40	15 6
11	10 01	16 6	10 12	16 8	10 23	17 0	10 34	17 2
12	10 92	18 2	11 04	18 4	11 16	18 6	11 28	18 8
13	11 83	19 7	11 96	19 9	12 09	20 1	12 22	20 3
14	12 74	21 2	12 88	21 4	13 02	21 7	13 16	21 9
15	13 65	22 7	13 80	23 0	13 95	23 2	14 10	23 5
16	14 56	24 2	14 72	24 5	14 88	24 8	15 04	25 0
17	15 47	25 7	15 64	26 0	15 81	26 3	15 98	26 6
18	16 38	27 3	16 56	27 6	16 74	27 9	16 92	28 2
19	17 29	28 8	17 48	29 1	17 67	29 4	17 86	29 7
20	18 20	30 3	18 40	30 6	18 60	31 0	18 80	31 1
21	19 11	31 8	19 32	32 2	19 53	32 5	19 74	32 9
22	20 02	33 3	20 24	33 7	20 46	34 1	20 68	34 4
23	20 93	34 8	21 16	35 2	21 39	35 6	21 62	36 0
24	21 84	36 4	22 08	36 8	22 32	37 2	22 56	37 6
25	22 75	37 9	23 00	38 3	23 25	38 7	23 50	39 1
26	23 66	39 4	23 92	39 8	24 18	40 3	24 44	40 7
27	24 57	40 9	24 84	41 4	25 11	41 8	25 38	42 3
28	25 48	42 4	25 76	42 9	26 04	43 4	26 32	43 8
29	26 39	43 9	26 68	44 4	26 97	44 9	27 26	45 4
30	27 30	45 5	27 60	46 0	27 90	46 5	28 20	47 0
40	36 40	60 6	36 80	61 3	37 20	62 0	37 60	62 6
50	45 50	75 8	46 00	76 6	46 50	77 5	47 00	78 3
100	91 00	151 6	92 00	153 3	93 00	155 0	94 00	156 6

No. of Bushels and Pounds.	AT 95 CENTS PER BUSHEL.		AT 96 CENTS PER BUSHEL.		AT 97 CENTS PER BUSHEL.		AT 98 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	95	1 5	96	1 6	97	1 6	98	1 6
2	1 90	3 1	1 92	3 2	1 94	3 2	1 96	3 2
3	2 85	4 7	2 88	4 8	2 91	4 8	2 94	4 9
4	3 80	6 3	3 84	6 4	3 88	6 4	3 92	6 5
5	4 75	7 9	4 80	8 0	4 85	8 0	4 90	8 1
6	5 70	9 5	5 76	9 6	5 82	9 7	5 88	9 8
7	6 65	11 0	6 72	11 2	6 79	11 3	6 86	11 4
8	7 60	12 6	7 68	12 8	7 76	12 9	7 84	13 0
9	8 55	14 2	8 64	14 4	8 73	14 5	8 82	14 7
10	9 50	15 8	9 60	16 0	9 70	16 1	9 80	16 3
11	10 45	17 4	10 56	17 6	10 67	17 7	10 78	17 9
12	11 40	19 0	11 52	19 2	11 64	19 4	11 76	19 6
13	12 35	20 5	12 48	20 8	12 61	21 0	12 74	21 2
14	13 30	22 1	13 44	22 4	13 58	22 6	13 72	22 8
15	14 25	23 7	14 40	24 0	14 55	24 2	14 70	24 5
16	15 20	25 3	15 36	25 6	15 52	25 8	15 68	26 1
17	16 15	26 4	16 32	27 2	16 49	27 4	16 66	27 7
18	17 10	28 5	17 28	28 8	17 46	29 1	17 64	29 4
19	18 05	30 0	18 24	30 4	18 43	30 7	18 62	31 0
20	19 00	31 6	19 20	32 0	19 40	32 3	19 60	32 6
21	19 95	33 2	20 16	33 6	20 37	33 9	20 58	34 3
22	20 90	34 8	21 22	35 2	21 34	35 5	21 56	35 9
23	21 85	36 4	22 08	36 8	22 31	37 1	22 54	37 5
24	22 80	38 0	23 04	38 4	23 28	38 8	23 52	39 2
25	23 75	39 5	24 00	40 0	24 25	40 4	24 50	40 8
26	24 70	41 1	24 96	41 6	25 22	42 0	25 48	42 4
27	25 65	42 7	25 92	43 2	26 19	43 6	26 46	44 1
28	26 60	44 3	26 88	44 8	27 16	45 2	27 44	45 7
29	27 55	45 9	27 84	46 4	28 13	46 8	28 42	47 3
30	28 50	47 5	28 80	48 0	29 10	48 5	29 40	49 0
40	38 00	63 3	38 40		38 80	64 6	39 20	65 3
50	47 50	79 1	48 00	80 0	48 50	80 8	49 00	81 6
100	95 00	158 3	96 00	160 0	97 00	161 6	98 00	163 3

No. of Bushels and Pounds.	AT 99 CENTS PER BUSHEL.		AT 100 CENTS PER BUSHEL.		AT 101 CENTS PER BUSHEL.		AT 102 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	99	1 6	1 00	1 6	1 01	1 6	1 02	1 7
2	1 98	3 3	2 00	3 3	2 02	3 3	2 04	3 4
3	2 97	4 9	3 00	5 0	3 03	5 0	3 06	5 1
4	3 96	6 6	4 00	6 6	4 04	6 7	4 08	6 8
5	4 95	8 2	5 00	8 3	5 05	8 4	5 10	8 5
6	5 94	9 9	6 00	10 0	6 06	10 1	6 12	10 2
7	6 93	11 5	7 00	11 6	7 07	11 7	7 14	11 9
8	7 92	13 2	8 00	13 3	8 08	13 4	8 16	13 6
9	8 91	14 8	9 00	15 0	9 09	15 1	9 18	15 3
10	9 90	16 5	10 00	16 6	10 10	16 8	10 20	17 0
11	10 89	18 1	11 00	18 3	11 11	18 5	11 22	18 7
12	11 88	19 8	12 00	20 0	12 12	20 2	12 24	20 4
13	12 87	21 4	13 00	21 6	13 13	21 8	13 26	22 1
14	13 86	23 1	14 00	23 3	14 14	23 5	14 28	23 8
15	14 85	24 7	15 00	25 0	15 15	25 2	15 30	25 5
16	15 84	26 4	16 00	26 6	16 16	26 9	16 32	27 2
17	16 83	28 0	17 00	28 3	17 17	28 6	17 34	28 9
18	17 82	29 7	18 00	30 0	18 18	30 3	18 36	30 6
19	18 81	31 3	19 00	31 6	19 19	31 9	19 38	32 3
20	19 80	33 0	20 00	33 3	20 20	33 6	20 40	34 0
21	20 79	34 6	21 00	35 0	21 21	35 3	21 42	35 7
22	21 78	36 3	22 00	36 6	22 22	37 0	22 44	37 4
23	22 77	37 9	23 00	38 3	23 23	38 7	23 46	39 1
24	23 76	39 6	24 00	40 0	24 24	40 4	24 48	40 8
25	24 75	41 2	25 00	41 6	25 25	42 0	25 50	42 5
26	25 74	42 9	26 00	43 3	26 26	43 7	26 52	44 2
27	26 73	44 5	27 00	45 0	27 27	45 4	27 54	45 9
28	27 72	46 2	28 00	46 6	28 28	47 1	28 56	47 6
29	28 71	47 8	29 00	48 3	29 29	48 8	29 58	49 3
30	29 70	49 5	30 00	50 0	30 30	50 5	30 60	51 0
40	39 60	66 0	40 00	66 6	40 40	67 3	40 80	68 0
50	49 50	82 5	50 00	83 3	50 50	84 1	51 00	85 0
100	99 00	165 0	100 00	166 6	101 00	168 3	102 00	170 0

No. of Bushels and Pounds.	AT 103 CENTS PER BUSHEL		AT 104 CENTS PER BUSHEL.		AT 105 CENTS PER BUSHEL.		AT 106 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	1 03	1 7	1 04	1 7	1 05	1 7	1 06	1 7
2	2 06	3 4	2 08	3 4	2 10	3 5	2 12	3 5
3	3 09	5 1	3 12	5 2	3 15	5 2	3 18	5 3
4	4 12	6 8	4 16	6 9	4 20	7 0	4 24	7 0
5	5 15	8 5	5 20	8 6	5 25	8 7	5 30	8 8
6	6 18	10 3	6 24	10 4	6 30	10 5	6 36	10 6
7	7 21	12 0	7 28	12 1	7 35	12 2	7 42	12 3
8	8 24	13 7	8 32	13 8	8 40	14 0	8 48	14 1
9	9 27	15 4	9 36	15 6	9 45	15 7	9 54	15 9
10	10 30	17 1	10 40	17 3	10 50	17 5	10 60	17 6
11	11 33	18 8	11 44	19 0	11 55	19 2	11 66	19 4
12	12 36	20 6	12 48	20 8	12 60	21 0	12 72	21 2
13	13 39	22 3	13 52	22 5	13 65	22 7	13 78	22 9
14	14 42	24 0	14 56	24 2	14 70	24 5	14 84	24 7
15	15 45	25 7	15 60	26 0	15 75	26 2	15 90	26 5
16	16 48	27 4	16 64	27 7	16 80	28 0	16 96	28 2
17	17 51	29 1	17 68	29 4	17 85	29 7	18 02	30 0
18	18 54	30 9	18 72	30 7	18 90	31 5	19 08	31 8
19	19 57	32 7	19 76	32 9	19 95	33 2	20 14	33 5
20	20 60	34 3	20 80	34 6	21 00	35 0	21 20	35 3
21	21 63	36 0	21 84	36 4	22 05	36 7	22 26	37 1
22	22 66	37 7	22 88	38 1	23 10	38 5	23 32	38 8
23	23 69	39 4	23 92	39 8	24 15	40 2	24 38	40 6
24	24 72	41 2	24 96	41 6	25 20	42 0	25 44	42 4
25	25 75	42 9	26 00	43 3	26 25	43 7	26 50	44 1
26	26 78	44 6	27 04	45 0	27 30	45 5	27 56	45 9
27	27 81	46 3	28 08	46 8	28 35	47 2	28 62	47 7
28	28 84	48 0	29 12	48 5	29 40	49 0	29 68	49 4
29	29 87	49 7	30 16	50 2	30 45	50 7	30 74	51 2
30	30 90	51 5	31 20	52 0	31 50	52 5	31 80	53 0
40	41 20	68 6	41 60	69 3	42 00	70 0	42 40	70 6
50	51 50	85 8	52 00	86 6	52 50	87 5	53 00	88 3
100	103 00	171 7	104 00	173 3	105 00	175 0	106 00	176 6

No. of Bushels and Pounds.	AT 107 CENTS PER BUSHEL.		AT 108 CENTS PER BUSHEL.		AT 109 CENTS PER BUSHEL.		AT 110 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	1 07	1 7	1 08	1 8	1 09	1 8	1 10	1 8
2	2 14	3 5	2 16	3 6	2 18	3 6	2 20	3 6
3	3 21	5 3	3 24	5 4	3 27	5 4	3 30	5 5
4	4 28	7 1	4 32	7 2	4 36	7 2	4 40	7 3
5	5 35	9 8	5 40	9 0	5 45	9 0	5 50	9 1
6	6 42	10 7	6 48	10 8	6 54	10 9	6 60	11 0
7	7 49	12 4	7 56	12 6	7 63	12 7	7 70	12 8
8	8 56	14 2	8 64	14 4	8 72	14 5	8 80	14 6
9	9 63	16 0	9 72	16 2	9 81	16 3	9 90	16 5
10	10 70	17 8	10 80	18 0	10 90	18 1	11 00	18 3
11	11 77	19 6	11 88	19 8	11 99	19 9	12 10	20 1
12	12 84	21 4	12 96	21 6	13 08	21 8	13 20	22 0
13	13 91	23 1	14 04	23 4	14 17	23 6	14 30	23 8
14	14 98	24 9	15 12	25 2	15 26	25 4	15 40	25 6
15	16 05	26 7	16 20	27 0	16 35	27 2	16 50	27 5
16	17 12	28 5	17 28	28 8	17 44	29 0	17 60	29 3
17	18 19	30 3	18 36	30 6	18 53	30 8	18 70	31 1
18	19 26	32 1	19 44	32 4	19 62	32 7	19 80	33 0
19	20 33	33 8	20 52	34 2	20 71	34 5	20 90	34 8
20	21 40	35 6	21 60	36 0	21 80	36 3	22 00	36 6
21	22 47	37 4	22 68	37 8	22 89	38 1	23 10	38 5
22	23 54	39 2	23 76	39 6	23 98	39 9	24 20	40 3
23	24 61	41 0	24 84	41 4	25 07	41 7	25 30	42 1
24	25 68	42 8	25 92	43 2	26 16	43 6	26 40	44 0
25	26 75	44 5	27 00	45 0	27 25	45 4	27 50	45 8
26	27 82	46 3	28 08	46 8	28 34	47 2	28 60	47 6
27	28 89	48 1	29 16	48 6	29 43	49 0	29 70	49 5
28	29 96	49 9	30 24	50 4	30 52	50 8	30 80	51 3
29	31 03	51 7	31 32	52 2	31 61	52 6	31 90	53 1
30	32 10	53 5	32 40	54 0	32 70	54 5	33 00	55 0
40	42 80	71 3	43 20	82 0	43 60	72 6	44 00	73 3
50	53 50	89 1	54 00	90 0	54 50	90 8	55 00	91 6
100	107 00	178 3	108 00	180 0	109 00	181 6	110 00	183 3

No. of Bushels and Pounds.	AT 111 CENTS PER BUSHEL.		AT 112 CENTS PER BUSHEL.		AT 113 CENTS PER BUSHEL.		AT 114 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	1 11	1 8	1 12	1 8	1 13	1 8	1 14	1 9
2	2 22	3 7	2 24	3 7	2 26	3 7	2 28	3 8
3	3 33	5 5	3 36	5 6	3 39	5 6	3 42	5 7
4	4 44	7 4	4 48	7 4	4 52	7 5	4 56	7 6
5	5 55	9 2	5 60	9 3	5 65	9 4	5 70	9 5
6	6 66	11 1	6 72	11 2	6 78	11 3	6 84	11 4
7	7 77	12 9	7 84	13 0	7 91	13 1	7 98	13 3
8	8 88	14 3	8 96	14 9	9 04	15 0	9 12	15 2
9	9 99	16 6	10 08	16 8	10 17	16 9	10 26	17 1
10	11 10	18 5	11 20	18 6	11 30	18 8	11 40	19 0
11	12 21	20 3	12 32	20 5	12 43	20 7	12 54	20 9
12	13 32	22 2	13 44	22 4	13 56	22 6	13 68	22 8
13	14 43	24 0	14 56	24 2	14 69	24 4	14 82	24 7
14	15 54	25 9	15 68	26 1	15 82	26 3	15 96	26 6
15	16 65	27 7	16 80	28 0	16 95	28 2	17 10	28 5
16	17 76	29 6	17 92	29 8	18 08	30 1	18 24	30 4
17	18 87	31 4	19 04	31 7	19 21	32 0	19 38	32 3
18	19 98	33 3	20 16	33 6	20 34	33 9	20 52	34 2
19	21 09	35 1	21 28	35 4	21 47	35 7	21 66	36 1
20	22 20	37 0	22 40	37 3	22 60	37 6	22 80	38 0
21	23 31	38 8	23 52	39 2	23 73	39 5	23 94	39 9
22	24 42	40 7	24 64	41 0	24 86	41 4	25 08	41 8
23	25 53	42 5	25 76	42 9	25 99	43 3	26 22	43 7
24	26 64	44 4	26 88	44 8	27 12	45 2	27 36	45 6
25	27 75	46 2	28 00	46 6	28 25	47 0	28 50	47 5
26	28 86	48 1	29 12	48 5	29 38	48 9	29 64	49 4
27	29 97	49 9	30 24	50 4	30 51	50 8	30 78	51 3
28	31 08	51 8	31 36	52 2	31 64	52 7	31 92	53 2
29	32 19	53 6	32 48	54 1	32 77	54 6	33 06	55 1
30	33 30	55 5	33 60	56 0	33 90	56 5	34 20	57 0
40	44 40	74 0	44 80	74 6	45 20	75 3	45 60	76 0
50	55 50	92 5	56 00	93 3	56 50	94 1	57 00	95 0
100	111 00	185 0	112 00	186 6	113 00	188 3	114 00	190 0

No. of Bushels and Pounds.	AT 115 CENTS PER BUSHEL.		AT 116 CENTS PER BUSHEL.		AT 117 CENTS PER BUSHEL.		AT 118 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	1 15	1 9	1 16	1 9	1 17	1 9	1 18	1 9
2	2 30	3 8	2 32	3 8	2 34	3 9	2 36	3 9
3	3 45	5 7	3 48	5 8	3 51	5 8	3 54	5 9
4	4 60	7 6	4 64	7 7	4 68	7 8	4 72	7 8
5	5 75	9 5	5 80	9 6	5 85	9 7	5 90	9 8
6	6 90	11 5	6 96	11 6	7 02	11 7	7 08	11 8
7	8 05	13 4	8 12	13 5	8 19	13 6	8 26	13 7
8	9 20	15 3	9 28	15 4	9 36	15 6	9 44	15 7
9	10 35	17 2	10 44	17 4	10 53	17 5	10 62	17 7
10	11 50	19 1	11 60	19 3	11 70	19 5	11 80	19 6
11	12 65	21 0	12 76	21 2	12 87	21 4	12 98	21 6
12	13 80	23 0	13 92	23 2	14 04	23 4	14 16	23 6
13	14 95	24 9	15 08	25 1	15 21	25 3	15 34	25 5
14	16 10	26 8	16 24	27 0	16 38	27 3	16 52	27 5
15	17 25	28 7	17 40	29 0	17 55	29 2	17 70	29 5
16	18 40	30 6	18 56	30 9	18 72	31 2	18 88	31 4
17	19 55	32 5	19 72	32 8	19 89	33 1	20 06	33 4
18	20 70	34 5	20 88	34 8	21 06	35 1	21 24	35 4
19	21 85	36 4	22 04	36 7	22 23	37 0	22 42	37 3
20	23 00	38 3	23 20	38 6	23 40	39 0	23 60	39 3
21	24 15	40 2	24 36	40 6	24 57	40 9	24 78	41 3
22	25 30	42 1	25 52	42 5	25 74	42 9	25 96	43 2
23	26 45	44 0	26 68	44 4	26 91	44 8	27 14	45 2
24	27 60	46 0	27 84	46 4	28 08	46 8	28 32	47 2
25	28 75	47 9	29 00	48 3	29 24	48 7	29 50	49 1
26	29 90	49 8	30 16	50 2	30 42	50 7	30 68	51 1
27	31 05	51 7	31 32	52 2	31 59	52 6	31 86	53 1
28	32 20	53 6	32 48	54 1	32 76	54 6	33 04	55 0
29	33 35	55 5	33 64	56 0	33 93	56 6	34 22	57 0
30	34 50	57 5	34 80	58 0	35 10	58 5	35 40	59 0
40	46 00	76 6	46 40	77 3	46 80	78 0	47 20	78 6
50	57 50	95 8	58 00	96 6	58 50	97 5	59 00	98 3
100	115 00	191 6	116 00	193 3	117 00	195 0	118 00	196 6

No. of Bushels and Pounds.	AT 119 CENTS PER BUSHEL.		AT 120 CENTS PER BUSHEL.		AT 121 CENTS PER BUSHEL.		AT 122 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	1 19	1 9	1 20	2 0	1 21	2 0	1 22	2 0
2	2 38	3 9	2 40	4 0	2 42	4 0	2 44	4 0
3	3 57	5 9	3 60	6 0	3 63	6 0	3 66	6 1
4	4 76	7 9	4 80	8 0	4 84	8 0	4 88	8 1
5	5 95	9 9	6 00	10 0	6 05	10 0	6 10	10 1
6	7 14	11 9	7 20	12 0	7 26	12 1	7 32	12 2
7	8 33	13 8	8 40	14 0	8 47	14 1	8 54	14 2
8	9 52	15 8	9 60	16 0	9 68	16 1	9 76	16 2
9	10 71	17 8	10 80	18 0	10 89	18 1	10 98	18 3
10	11 90	19 8	12 00	20 0	12 10	20 1	12 20	20 3
11	13 09	21 8	13 20	22 0	13 31	22 1	13 42	22 3
12	14 28	23 8	14 40	24 0	14 52	24 2	14 64	24 4
13	15 47	25 7	15 60	26 0	15 73	26 2	15 86	26 4
14	16 66	27 7	16 80	28 0	16 94	28 2	17 08	28 4
15	17 85	29 7	18 00	30 0	18 15	30 2	18 30	30 5
16	19 04	31 7	19 20	32 0	19 36	32 2	19 52	32 5
17	20 23	33 7	20 40	34 0	20 57	34 2	20 74	34 5
18	21 42	35 7	21 60	36 0	21 78	36 3	21 96	36 6
19	22 61	37 6	22 80	38 0	22 99	38 3	23 18	38 6
20	23 80	39 6	24 00	40 0	24 20	40 3	24 40	40 6
21	24 99	41 6	25 20	42 0	25 41	42 3	25 62	42 7
22	26 18	43 6	26 40	44 0	26 62	44 3	26 84	44 7
23	27 37	45 6	27 60	46 0	27 83	46 3	28 06	46 7
24	28 56	47 6	28 80	48 0	29 04	48 4	29 28	48 8
25	29 75	49 5	30 00	50 0	30 25	50 4	30 50	50 8
26	30 94	51 5	31 20	52 0	31 46	52 4	31 72	52 8
27	32 13	53 5	32 40	54 0	32 67	54 4	32 94	54 9
28	33 32	55 5	33 60	56 0	33 88	56 4	34 16	56 9
29	34 51	57 5	34 80	58 0	35 09	58 4	35 38	58 9
30	35 70	59 5	36 00	60 0	36 30	60 5	36 60	61 0
40	47 60	79 3	48 00	80 0	48 40	80 6	48 80	81 3
50	59 50	99 1	60 00	100 0	60 50	100 8	61 00	101 6
100	119 00	198 3	120 00	200 0	121 00	201 6	122 00	203 3

No. of Bushels and Pounds.	AT 123 CENTS PER BUSHEL.		AT 124 CENTS PER BUSHEL.		AT 125 CENTS PER BUSHEL.		AT 126 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	1 23	2 0	1 24	2 0	1 25	2 0	1 26	2 1
2	2 46	4 1	2 48	4 1	2 50	4 1	2 52	4 2
3	3 69	6 1	3 72	6 2	3 75	6 2	3 78	6 3
4	4 92	8 2	4 96	8 2	5 00	8 3	5 04	8 4
5	6 15	10 2	6 20	10 3	6 25	10 4	6 30	10 5
6	7 38	12 3	7 44	12 4	7 50	12 5	7 56	12 6
7	8 61	14 3	8 68	14 4	8 75	14 5	8 82	14 7
8	9 84	16 4	9 92	16 5	10 00	16 6	10 08	16 8
9	11 07	18 4	11 16	18 6	11 25	18 7	11 34	18 9
10	12 30	20 5	12 40	20 6	12 50	20 8	12 60	21 0
11	13 53	22 5	13 64	22 7	13 75	22 9	13 86	23 1
12	14 76	24 6	14 88	24 8	15 00	25 0	15 12	25 2
13	15 99	26 6	16 12	26 8	16 25	27 0	16 38	27 3
14	17 22	28 7	17 36	28 9	17 50	29 1	17 64	29 4
15	18 45	30 7	18 60	31 0	18 75	31 2	18 90	31 5
16	19 68	32 8	19 84	33 1	20 00	33 3	20 16	33 6
17	20 91	34 8	21 08	35 1	21 25	35 4	21 42	35 7
18	22 14	36 9	22 32	37 2	22 50	37 5	22 68	37 8
19	23 37	38 9	23 56	39 2	23 75	39 5	23 94	39 9
20	24 60	41 0	24 80	41 3	25 00	41 6	25 20	42 0
21	25 83	43 0	26 04	43 4	26 25	43 7	25 46	44 1
22	27 06	45 1	27 28	45 4	27 50	45 8	27 72	46 2
23	28 29	47 1	28 52	47 5	28 75	47 9	28 98	48 3
24	29 52	49 2	29 76	49 6	30 00	50 0	30 24	50 4
25	30 75	51 3	31 00	51 6	31 25	52 0	31 50	52 5
26	31 98	53 3	32 24	53 7	32 50	54 1	32 76	54 6
27	33 21	55 3	33 48	55 8	33 75	56 2	34 02	56 7
28	34 44	57 4	34 72	57 8	35 00	58 3	35 28	58 8
29	35 67	59 4	35 96	59 9	36 25	60 4	36 54	60 9
30	36 90	61 5	37 20	62 0	37 50	62 5	37 80	63 0
40	49 20	82 0	49 60	82 6	50 00	83 3	50 40	84 0
50	61 50	102 5	62 00	103 3	62 50	104 1	63 00	105 0
100	123 00	205 0	124 00	206 6	125 00	208 3	126 00	210 0

No. of Bushels and Pounds.	AT 127 CENTS PER BUSHEL.		AT 128 CENTS PER BUSHEL.		AT 129 CENTS PER BUSHEL.		AT 130 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	1 27	2 1	1 28	2 1	1 29	2 1	1 30	2 1
2	2 54	4 2	2 56	4 2	2 58	4 3	2 60	4 3
3	3 81	6 3	3 84	6 4	3 87	6 4	3 90	6 5
4	5 08	8 4	5 12	8 5	5 16	8 6	5 20	8 6
5	6 35	10 5	6 40	10 6	6 45	10 7	6 50	10 8
6	7 62	12 7	7 68	12 8	7 74	12 9	7 80	13 0
7	8 89	14 8	8 96	14 9	9 03	15 0	9 10	15 1
8	10 16	16 9	10 24	17 0	10 32	17 2	10 40	17 3
9	11 43	19 0	11 52	19 2	11 61	19 3	11 70	19 5
10	12 70	21 1	12 80	21 3	12 90	21 5	13 00	21 6
11	13 97	23 2	14 08	23 4	14 19	23 6	14 30	23 8
12	15 24	25 4	15 36	25 6	15 48	25 8	15 60	26 0
13	16 51	27 5	16 64	27 7	16 77	27 9	16 90	28 1
14	17 78	29 6	17 92	29 8	18 06	30 1	18 20	30 3
15	19 05	31 7	19 20	32 0	19 35	32 2	19 50	32 5
16	20 32	33 8	20 48	34 1	20 64	34 4	20 80	34 6
17	21 59	35 9	21 76	36 2	21 93	36 5	22 10	36 8
18	22 86	38 1	23 04	38 4	23 22	38 7	23 40	39 0
19	24 13	40 2	24 32	40 5	24 51	40 8	24 70	41 1
20	25 40	42 3	25 60	42 6	25 80	43 0	26 00	43 3
21	26 67	44 4	26 88	44 8	27 09	45 1	27 30	45 5
22	27 94	46 5	28 16	46 9	28 38	47 3	28 60	47 6
23	29 21	48 6	29 44	49 0	29 67	49 4	29 90	49 8
24	30 48	50 8	30 72	51 2	30 96	51 6	31 20	52 0
25	31 75	52 9	32 00	53 3	32 25	53 7	32 50	54 1
26	33 02	55 0	33 28	55 4	33 54	55 9	33 80	56 3
27	34 29	57 1	34 56	57 6	34 83	58 0	35 10	58 5
28	35 56	59 2	35 84	59 7	36 12	60 2	36 40	60 6
29	36 83	61 3	37 12	61 8	37 41	62 3	37 70	62 8
30	38 10	63 5	38 40	64 0	38 70	64 5	39 00	65 0
40	50 80	84 6	51 20	85 3	51 60	86 0	52 00	86 6
50	63 50	105 8	64 00	106 6	64 50	107 5	65 00	108 3
100	127 00	211 6	128 00	213 3	129 00	215 0	130 00	216 6

No. of Bushels and Pounds.	AT 131 CENTS PER BUSHEL.		AT 132 CENTS PER BUSHEL.		AT 133 CENTS PER BUSHEL.		AT 134 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	1 31	2 1	1 32	2 2	1 33	2 2	1 34	2 2
2	2 62	4 3	2 64	4 4	2 66	4 4	2 68	4 4
3	3 93	6 5	3 96	6 6	3 99	6 6	4 02	6 7
4	5 24	8 7	5 28	8 8	5 32	8 8	5 36	8 9
5	6 55	10 9	6 60	11 0	6 65	11 0	6 70	11 1
6	7 86	13 1	7 92	13 2	7 98	13 3	8 04	13 4
7	9 17	15 2	9 24	15 4	9 31	15 5	9 38	15 6
8	10 48	17 4	10 56	17 6	10 64	17 7	10 72	17 8
9	11 79	19 6	11 88	19 8	11 97	19 9	12 06	20 1
10	13 10	21 8	13 20	22 0	13 30	22 1	13 40	22 3
11	14 41	24 0	14 52	24 2	14 63	24 3	14 74	24 5
12	15 72	26 2	15 84	26 4	15 96	26 6	16 08	26 8
13	17 03	28 3	17 16	28 6	17 29	28 8	17 42	29 0
14	18 34	30 5	18 48	30 8	18 62	31 0	18 76	31 2
15	19 65	32 7	19 80	33 0	19 95	33 2	20 10	33 5
16	20 96	34 9	21 12	35 2	21 28	35 4	21 44	35 7
17	22 27	37 1	22 44	37 4	22 61	37 6	22 78	37 9
18	23 58	39 3	23 76	39 6	23 94	39 9	24 12	40 2
19	24 89	41 4	25 08	41 8	25 27	42 1	25 46	42 4
20	26 20	43 6	26 40	44 0	26 60	44 3	26 80	44 6
21	27 51	45 8	27 72	46 2	27 93	46 5	28 14	46 9
22	28 82	48 0	29 04	48 4	29 26	48 7	29 48	49 1
23	30 13	50 2	30 36	50 6	30 59	50 9	30 82	51 3
24	31 44	52 4	31 68	52 8	31 92	53 2	32 16	53 6
25	32 75	54 5	33 00	55 0	33 25	55 4	33 50	55 8
26	34 06	56 7	34 32	57 2	34 58	57 6	34 84	58 0
27	35 37	58 9	35 64	59 4	35 91	59 8	36 18	60 3
28	36 68	61 1	36 96	61 6	37 24	62 0	37 52	62 5
29	37 99	63 3	38 28	63 8	38 57	64 2	38 86	64 7
30	39 30	65 5	39 60	66 0	39 90	66 5	40 20	67 0
40	52 40	87 3	52 80	88 0	53 20	68 6	53 60	89 3
50	65 50	109 1	66 00	110 0	66 50	110 8	67 00	111 6
100	131 00	218 3	132 00	220 0	133 00	221 6	134 00	223 3

No. of Bushels and Pounds.	AT 135 CENTS PER BUSHEL.		AT 136 CENTS PER BUSHEL.		AT 137 CENTS PER BUSHEL.		AT 138 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	1 35	2 2	1 36	2 2	1 37	2 2	1 38	2 3
2	2 70	4 5	2 72	4 5	2 74	4 5	2 76	4 6
3	4 05	6 7	4 08	6 8	4 11	6 8	4 14	6 9
4	5 40	9 0	5 44	9 0	5 48	9 1	5 52	9 2
5	6 75	11 2	6 80	11 3	6 85	11 4	6 90	11 5
6	8 10	13 5	8 16	13 6	8 22	13 7	8 28	13 8
7	9 45	15 7	9 52	15 8	9 59	15 9	9 66	16 1
8	10 80	18 0	10 88	18 1	10 96	18 2	11 04	18 4
9	12 15	20 2	12 24	20 4	12 33	20 5	12 42	20 7
10	13 50	22 5	13 60	22 6	13 70	22 8	13 80	23 0
11	14 85	24 7	14 96	24 9	15 07	25 1	15 18	25 3
12	16 20	27 0	16 32	27 2	16 44	27 4	16 56	27 6
13	17 55	29 2	17 68	29 4	17 81	29 6	17 94	29 9
14	18 90	31 5	19 04	31 7	19 18	31 9	19 32	32 2
15	20 25	33 7	20 40	34 0	20 55	34 2	20 70	34 5
16	21 60	36 0	21 76	36 2	21 92	36 5	22 08	36 8
17	22 95	38 2	23 12	38 5	23 29	38 8	23 46	39 1
18	24 30	40 5	24 48	40 8	24 66	41 1	24 84	41 4
19	25 65	42 7	25 84	43 0	26 03	43 3	26 22	43 7
20	27 00	45 0	27 20	45 3	27 40	45 6	27 60	46 0
21	28 35	47 2	28 56	47 6	28 77	47 9	28 98	48 3
22	29 70	49 5	29 92	49 8	30 14	50 2	30 36	50 6
23	31 05	51 7	31 28	52 1	31 51	52 5	31 74	52 9
24	32 40	54 0	32 64	54 4	32 88	54 8	33 12	55 2
25	33 75	56 2	34 00	56 6	34 25	57 0	34 50	57 5
26	35 10	58 5	35 36	58 9	35 62	59 3	35 88	59 8
27	36 45	60 7	36 72	61 2	36 99	61 6	37 26	62 1
28	37 80	63 0	38 08	63 4	38 36	63 9	38 64	64 4
29	39 15	65 2	39 44	65 7	39 73	66 2	40 02	66 7
30	40 50	67 5	40 80	68 0	41 10	68 5	41 40	69 0
40	54 00	90 0	54 40	90 6	54 80	91 3	55 20	92 0
50	67 50	112 5	68 00	113 3	68 50	114 1	69 00	115 0
100	135 00	225 0	136 00	226 6	137 00	228 3	138 00	230 0

No. of Bushels and Pounds.	AT 139 CENTS PER BUSHEL.		AT 140 CENTS PER BUSHEL.		AT 141 CENTS PER BUSHEL.		AT 142 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	1 39	2 3	1 40	2 3	1 41	2 3	1 42	2 3
2	2 78	4 6	2 80	4 6	2 82	4 7	2 84	4 7
3	4 17	6 9	4 20	7 0	4 23	7 0	4 26	7 1
4	5 56	9 2	5 60	9 3	5 64	9 4	5 68	9 4
5	6 95	11 5	7 00	11 6	7 05	11 7	7 10	11 8
6	8 34	13 9	8 40	14 0	8 46	14 1	8 52	14 2
7	9 73	16 2	9 80	16 3	9 87	16 4	9 94	16 5
8	11 12	18 5	11 20	18 6	11 28	18 8	11 36	18 9
9	12 51	20 8	12 60	21 0	12 69	21 1	12 78	21 3
10	13 90	23 1	14 00	23 3	14 10	23 5	14 20	23 6
11	15 29	25 4	15 40	25 6	15 51	25 8	15 62	26 0
12	16 68	27 8	16 80	28 0	16 92	28 2	17 04	28 4
13	18 07	30 1	18 20	30 3	18 53	30 8	18 46	30 7
14	19 46	32 4	19 60	32 6	19 74	32 9	19 88	33 1
15	20 85	34 7	21 00	35 0	21 15	35 2	21 30	35 5
16	22 24	37 0	22 40	37 3	22 56	37 6	22 72	37 8
17	23 63	39 3	23 80	39 6	23 97	39 9	24 14	40 2
18	25 02	41 7	25 20	42 0	25 38	42 3	25 56	42 6
19	26 41	44 0	26 60	44 3	26 79	44 6	26 98	44 9
20	27 80	46 3	28 00	46 6	28 20	47 0	28 40	47 3
21	29 19	48 6	29 40	49 0	29 61	49 3	29 82	49 7
22	30 58	50 9	30 80	51 3	31 02	51 7	31 24	52 0
23	31 97	53 2	32 20	53 6	32 43	54 0	32 66	54 4
24	33 36	55 6	33 60	56 0	33 84	56 4	34 08	56 8
25	34 75	57 9	35 00	58 3	35 25	58 7	35 50	59 1
26	36 14	60 2	36 40	60 6	36 66	61 1	36 92	61 5
27	37 53	62 5	37 80	63 0	38 07	63 4	38 34	63 9
28	38 92	64 8	39 20	65 3	39 48	65 8	39 76	66 2
29	40 31	67 1	40 60	67 6	40 89	68 1	41 18	68 6
30	41 70	69 5	42 00	70 0	42 30	70 5	42 60	71 0
40	55 60	92 6	56 00	93 3	56 40	94 0	56 80	94 6
50	69 50	115 8	70 00	116 6	70 50	117 5	71 00	118 3
100	139 00	231 6	140 00	233 3	141 00	235 0	142 00	236 6

No. of Bushels and Pounds.	AT 143 CENTS PER BUSHEL.		AT 144 CENTS PER BUSHEL.		AT 145 CENTS PER BUSHEL.		AT 146 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	1 43	2 3	1 44	2 4	1 45	2 4	1 46	2 4
2	2 86	4 7	2 88	4 8	2 90	4 8	2 92	4 8
3	4 29	7 1	4 32	7 2	4 35	7 2	4 38	7 3
4	5 72	9 5	5 76	9 6	5 80	9 6	5 84	9 7
5	7 15	11 9	7 20	12 0	7 25	12 0	7 30	12 1
6	8 58	14 3	8 64	14 4	8 70	14 5	8 76	14 6
7	10 01	16 6	10 08	16 8	10 15	16 9	10 22	17 0
8	11 44	19 0	11 52	19 2	11 60	19 3	11 68	19 4
9	12 87	21 4	12 96	21 6	13 05	21 7	13 14	21 9
10	14 30	23 8	14 40	24 0	14 50	24 1	14 60	24 3
11	15 73	26 2	15 84	26 4	15 95	26 5	16 06	26 7
12	17 16	28 6	17 28	28 8	17 40	29 0	17 52	29 2
13	18 59	30 9	18 72	31 2	18 85	31 4	18 98	31 6
14	20 02	33 3	20 16	33 6	20 30	33 8	20 44	34 0
15	21 45	35 7	21 60	36 0	21 75	36 2	21 90	36 5
16	22 88	38 1	23 04	38 4	23 20	38 6	23 36	38 9
17	24 31	40 5	24 48	40 8	24 65	41 0	24 82	41 3
18	25 74	42 9	25 92	43 2	26 10	43 5	26 28	43 8
19	27 17	45 2	27 36	45 6	27 55	45 9	27 74	46 2
20	28 60	47 6	28 80	48 0	29 00	48 3	29 20	48 6
21	30 03	50 0	30 24	50 4	30 45	50 7	30 66	51 1
22	31 45	52 4	31 68	52 8	31 90	53 1	32 12	53 5
23	32 89	54 8	33 12	55 2	33 35	55 5	33 58	55 9
24	34 32	57 2	34 56	57 6	34 80	58 0	35 04	58 4
25	35 75	59 5	36 00	60 0	36 25	60 4	36 50	60 8
26	37 18	61 9	37 44	62 4	37 70	62 8	37 95	63 2
27	38 61	64 3	38 88	64 8	39 15	65 2	39 42	65 7
28	40 04	66 7	40 32	67 2	40 60	67 6	40 88	68 1
29	41 47	69 1	41 76	69 6	42 05	70 0	42 34	70 5
30	42 90	71 5	43 20	72 0	43 50	72 5	43 80	73 0
40	57 20	95 3	57 60	96 0	58 00	96 6	58 40	97 3
50	71 50	119 1	72 00	120 0	72 50	120 8	73 00	121 6
100	143 00	238 3	144 00	240 0	145 00	241 6	146 00	243 3

No. of Bushels and Pounds.	AT 147 CENTS PER BUSHEL.		AT 148 CENTS PER BUSHEL.		AT 149 CENTS PER BUSHEL.		AT 150 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	1 47	2 4	1 48	2 4	1 49	2 4	1 50	2 5
2	2 91	4 9	2 96	4 9	2 98	4 9	3 00	5 0
3	4 41	7 3	4 44	7 4	4 47	7 4	4 50	7 5
4	5 88	9 8	5 92	9 8	5 96	9 9	6 00	10 0
5	7 35	12 2	7 40	12 3	7 45	12 4	7 50	12 5
6	8 82	14 7	8 88	14 8	8 94	14 9	9 00	15 0
7	10 29	17 1	10 36	17 2	10 43	17 3	10 50	17 5
8	11 76	19 6	11 84	19 7	11 92	19 8	12 00	20 0
9	13 23	22 0	13 32	22 2	13 41	22 3	13 50	22 5
10	14 70	24 5	14 80	24 6	14 90	24 8	15 00	25 0
11	16 17	26 9	16 28	27 1	16 39	27 3	16 50	27 5
12	17 64	29 4	17 76	29 6	17 88	29 8	18 00	30 0
13	19 11	31 8	19 24	32 0	19 37	32 2	19 50	32 5
14	20 58	34 3	20 72	34 5	20 86	34 7	21 00	35 0
15	22 05	36 7	22 20	37 0	22 35	37 2	22 50	37 5
16	23 52	39 2	23 68	39 4	23 84	39 7	24 00	40 0
17	24 99	41 6	25 16	41 9	25 33	42 2	25 50	42 5
18	26 46	44 1	26 64	44 4	26 82	44 7	27 00	45 0
19	27 93	46 5	28 12	46 8	28 31	47 1	28 50	47 5
20	29 40	49 0	29 60	49 3	29 80	49 6	30 00	50 0
21	30 87	51 4	31 08	51 8	31 29	52 1	31 50	52 5
22	32 34	53 9	32 56	54 2	32 78	54 6	33 00	55 0
23	33 81	56 3	34 04	56 7	34 27	57 1	34 50	57 5
24	35 28	58 8	35 52	59 2	35 76	59 6	36 00	60 0
25	36 75	61 2	37 00	61 6	37 25	62 0	37 50	62 5
26	38 22	63 7	38 48	64 1	38 74	64 5	39 00	65 0
27	39 69	66 1	39 96	66 6	40 23	67 0	40 50	67 5
28	41 16	68 6	41 44	69 0	41 72	69 5	42 00	70 0
29	42 63	71 0	42 92	71 5	43 21	72 0	43 50	72 5
30	44 10	73 5	44 40	74 0	44 70	74 5	45 00	75 0
40	58 80	98 0	59 20	98 6	59 60	99 3	60 00	100 0
50	73 50	122 5	74 00	123 3	74 50	124 1	75 00	125 0
100	147 00	245 0	148 00	246 6	149 00	218 3	150 00	250 0

No. of Bushels and Pounds.	AT 151 CENTS PER BUSHEL.		AT 152 CENTS PER BUSHEL.		AT 153 CENTS PER BUSHEL.		AT 154 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	1 51	2 5	1 52	2 5	1 53	2 5	1 54	2 5
2	3 02	5 0	3 04	5 0	3 06	5 1	3 08	5 1
3	4 53	7 5	4 56	7 6	4 59	7 6	4 62	7 7
4	6 04	10 0	6 08	10 1	6 12	10 2	6 16	10 2
5	7 55	12 5	7 60	12 6	7 65	12 7	7 70	12 8
6	9 06	15 1	9 12	15 2	9 18	15 3	9 24	15 4
7	10 57	17 6	10 64	17 7	10 71	17 8	10 78	17 9
8	12 08	20 1	12 16	20 2	12 24	20 4	12 32	20 5
9	13 59	22 6	13 68	22 8	13 77	22 9	13 86	23 1
10	15 10	25 1	15 20	25 3	15 30	25 5	15 40	25 6
11	16 61	27 6	16 72	27 8	16 83	28 0	16 94	28 2
12	18 12	30 2	18 24	30 4	18 36	30 6	18 48	30 8
13	19 63	32 7	19 76	32 9	19 89	33 1	20 02	33 3
14	21 14	35 2	21 28	35 4	21 42	35 7	21 56	35 9
15	22 65	37 7	22 80	38 0	22 95	38 2	23 10	38 5
16	24 16	40 2	24 32	40 5	24 48	40 8	24 64	41 0
17	25 67	42 7	25 84	43 0	26 01	43 3	26 18	43 6
18	27 18	45 3	27 36	45 6	27 54	45 9	27 72	46 2
19	28 69	47 8	28 88	48 1	29 07	48 4	29 26	48 7
20	30 20	50 3	30 40	50 6	30 60	51 0	30 80	51 3
21	31 71	52 8	31 92	53 2	32 13	53 5	32 34	53 9
22	33 22	55 3	33 44	55 7	33 66	56 1	33 88	56 4
23	34 73	57 8	34 96	58 2	35 19	58 6	35 42	59 0
24	36 24	60 4	36 48	60 8	36 72	61 2	36 96	61 6
25	37 75	62 9	38 00	63 3	38 25	63 7	38 50	64 1
26	39 26	65 4	39 52	65 8	39 78	66 3	40 04	66 7
27	40 77	67 9	41 04	68 4	41 31	68 8	41 58	69 3
28	42 28	70 4	42 56	70 9	42 84	71 4	43 12	71 8
29	43 79	72 9	44 08	73 4	44 37	73 9	44 66	74 4
30	45 30	75 5	45 60	76 0	45 90	76 5	46 20	77 0
40	60 40	100 6	60 80	101 3	61 20	102 0	61 60	102 6
50	75 50	125 8	76 00	126 6	76 50	127 5	77 00	128 3
100	151 00	251 6	152 00	253 3	153 00	255 0	154 00	256 6

No. of Bushels and Pounds.	AT 155 CENTS PER BUSHEL.		AT 156 CENTS PER BUSHEL.		AT 157 CENTS PER BUSHEL.		AT 158 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	1 55	2 5	1 56	2 6	1 57	2 6	1 58	2 6
2	3 10	5 1	3 12	5 2	3 14	5 2	3 16	5 2
3	4 65	7 7	4 68	7 8	4 71	7 8	4 74	7 9
4	6 20	10 3	6 24	10 4	6 28	10 4	6 32	10 5
5	7 75	12 9	7 80	13 0	7 85	13 0	7 90	13 1
6	9 30	15 5	9 36	15 6	9 42	15 7	9 48	15 8
7	10 85	18 0	10 92	18 2	10 99	18 3	11 06	18 4
8	12 40	20 6	12 48	20 8	12 56	20 9	12 64	21 0
9	13 95	23 2	14 04	23 4	14 13	23 5	14 22	23 7
10	15 50	25 8	15 60	26 0	15 70	26 1	15 80	26 3
11	17 05	28 4	17 16	28 6	17 27	28 7	17 38	28 9
12	18 60	31 0	18 72	31 2	18 84	31 4	18 96	31 6
13	20 15	33 5	20 28	33 8	20 41	34 0	20 54	34 2
14	21 70	36 1	21 84	36 4	21 98	36 6	22 12	36 8
15	23 25	38 7	23 40	39 0	23 55	39 2	23 70	39 5
16	24 80	41 3	24 96	41 6	25 12	41 8	25 28	42 1
17	26 35	43 9	26 52	44 2	26 69	44 4	26 86	44 7
18	27 90	46 5	28 08	46 8	28 26	47 1	28 44	47 4
19	29 45	49 0	29 64	49 4	29 83	49 7	30 02	50 0
20	31 00	51 6	31 20	52 0	31 40	52 3	31 60	52 6
21	32 55	54 2	32 76	54 6	32 97	54 9	33 18	55 3
22	34 10	56 8	34 32	57 2	34 54	57 5	34 76	57 9
23	35 65	59 4	35 88	59 8	36 11	60 1	36 34	60 5
24	37 20	62 0	37 44	62 4	37 68	62 8	37 92	63 2
25	38 75	64 5	39 00	65 0	39 25	65 4	39 50	65 8
26	40 30	67 1	40 56	67 6	40 82	68 0	41 08	68 4
27	41 85	69 7	42 12	70 2	42 39	70 6	42 66	71 1
28	43 40	72 3	43 68	72 8	43 96	73 2	44 24	73 7
29	44 95	74 9	45 24	75 4	45 53	75 8	45 82	76 3
30	46 50	77 5	46 80	78 0	47 10	78 5	47 40	79 0
40	62 00	103 3	62 40	104 0	62 80	104 6	63 20	105 3
50	77 50	129 1	78 00	130 0	78 50	130 8	79 00	131 6
100	155 00	258 3	156 00	260 0	157 00	261 6	158 00	263 3

No. of Bushels and Pounds.	AT 159 CENTS PER BUSHEL.		AT 160 CENTS PER BUSHEL.		AT 161 CENTS PER BUSHEL.		AT 162 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	1 59	2 6	1 60	2 6	1 61	2 6	1 62	2 7
2	3 18	5 3	3 20	5 3	3 22	5 3	3 24	5 4
3	4 77	7 9	4 80	8 0	4 83	8 0	4 86	8 1
4	6 36	10 6	6 40	10 6	6 44	10 7	6 48	10 8
5	7 95	13 2	8 00	13 3	8 05	13 4	8 10	13 5
6	9 54	15 9	9 60	16 0	9 66	16 1	9 72	16 2
7	11 13	18 5	11 20	18 6	11 27	18 7	11 34	18 9
8	12 72	21 2	12 80	21 3	12 88	21 4	12 96	21 6
9	14 31	23 8	14 40	24 0	14 49	24 1	14 58	24 3
10	15 90	26 5	16 00	26 6	16 10	26 8	16 20	27 0
11	17 49	29 1	17 60	29 3	17 71	29 5	17 82	29 7
12	19 08	31 8	19 20	32 0	19 32	32 2	19 44	32 4
13	20 67	34 4	20 80	34 6	20 93	34 8	21 06	35 1
14	22 26	37 1	22 40	37 3	22 54	37 5	22 68	37 8
15	23 85	39 7	24 00	40 0	24 15	40 2	24 30	40 5
16	25 44	42 4	25 60	42 6	25 76	42 9	25 92	43 2
17	27 03	45 0	27 20	45 3	27 37	45 6	27 54	45 9
18	28 62	47 7	28 80	48 0	28 98	48 3	29 16	48 6
19	30 21	50 3	30 40	50 6	30 59	50 9	30 78	51 3
20	31 80	53 0	32 00	53 3	32 20	53 6	32 40	54 0
21	33 39	55 6	33 60	56 0	33 81	56 3	34 02	56 7
22	34 98	58 3	35 20	58 6	35 42	59 0	35 64	59 4
23	36 57	60 9	36 80	61 3	37 03	61 7	37 26	62 1
24	38 16	63 6	38 40	64 0	38 34	64 4	38 88	64 8
25	39 75	66 2	40 00	66 6	40 25	67 0	40 50	67 5
26	41 34	68 9	41 60	69 3	41 86	69 7	42 12	70 2
27	42 93	71 5	43 20	72 0	43 47	72 4	43 74	72 9
28	44 52	74 2	44 80	74 6	45 08	75 1	45 36	75 6
29	46 11	76 8	46 40	77 3	46 69	77 8	46 98	78 3
30	47 70	79 5	48 00	80 0	48 30	80 5	48 60	81 0
40	63 60	106 0	64 00	106 6	64 40	107 3	64 80	108 0
50	79 50	132 5	80 00	133 3	80 50	134 1	81 00	135 0
100	159 00	265 0	160 00	266 6	161 00	268 3	162 00	270 0

No. of Bushels and Pounds.	AT 163 CENTS PER BUSHEL.		AT 164 CENTS PER BUSHEL.		AT 165 CENTS PER BUSHEL.		AT 166 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	1 63	2 7	1 64	2 7	1 65	2 7	1 66	2 7
2	3 26	5 4	3 28	5 4	3 30	5 5	3 32	5 5
3	4 89	8 1	4 92	8 2	4 95	8 2	4 98	8 3
4	6 52	10 8	6 56	10 9	6 60	11 0	6 64	11 0
5	8 15	13 5	8 20	13 6	8 25	13 7	8 30	13 8
6	9 78	16 3	9 84	16 4	9 90	16 5	9 96	16 6
7	11 41	19 0	11 48	19 1	11 55	19 2	11 62	19 3
8	13 04	21 7	13 12	21 8	13 20	22 0	13 28	22 1
9	14 67	24 4	14 76	24 6	14 85	24 7	14 94	24 9
10	16 30	27 1	16 40	27 3	16 50	27 5	16 60	27 6
11	17 93	29 8	18 04	30 0	18 15	30 2	18 26	30 4
12	19 56	32 6	19 68	32 8	19 80	33 0	19 92	33 2
13	21 19	35 3	21 32	35 5	21 45	35 7	21 58	35 9
14	22 82	38 0	22 96	38 2	23 10	38 5	23 24	38 7
15	24 45	40 7	24 60	41 0	24 75	41 2	24 90	41 5
16	26 08	43 4	26 24	43 7	26 40	44 0	26 56	44 2
17	27 71	46 1	27 88	46 4	28 05	46 7	28 22	47 0
18	29 34	48 9	29 52	49 2	29 70	49 5	29 88	49 8
19	30 97	51 6	31 16	51 9	31 35	52 2	31 54	52 5
20	32 60	54 3	32 80	54 6	33 00	55 0	33 20	55 3
21	34 23	57 0	34 44	57 4	34 65	57 7	34 86	58 1
22	35 86	59 7	36 08	60 1	36 30	60 5	36 52	60 8
23	37 49	62 4	37 72	62 8	37 95	63 2	38 18	63 6
24	39 12	65 2	39 36	65 6	39 60	66 0	39 84	66 4
25	40 75	67 9	41 00	68 3	41 25	68 7	41 50	69 1
26	42 38	70 6	42 64	71 0	42 90	71 5	43 16	71 9
27	44 01	73 3	44 28	73 8	44 55	74 2	44 82	74 7
28	45 64	76 0	45 92	76 5	46 20	77 0	46 48	77 4
29	47 27	78 7	47 56	79 2	47 85	79 7	48 14	80 2
30	48 90	81 5	49 20	82 0	49 50	82 5	49 80	83 0
40	65 20	108 6	65 60	109 3	66 00	110 0	66 40	110 6
50	81 50	135 8	82 00	136 6	82 50	137 5	83 00	138 3
100	163 00	271 6	164 00	273 3	165 00	275 0	166 00	276 6

No. of Bushels and Pounds.	AT 167 CENTS PER BUSHEL.		AT 168 CENTS PER BUSHEL.		AT 169 CENTS PER BUSHEL.		AT 170 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	1 67	2 7	1 68	2 8	1 69	2 8	1 70	2 8
2	3 34	5 5	3 36	5 6	3 38	5 6	3 40	5 6
3	5 01	8 3	5 04	8 4	5 07	8 4	5 10	8 5
4	6 68	11 1	6 72	11 2	6 76	11 2	6 80	11 3
5	8 35	13 9	8 40	14 0	8 45	14 0	8 50	14 1
6	10 02	16 7	10 08	16 8	10 14	16 9	10 20	17 0
7	11 69	19 4	11 76	19 6	11 83	19 7	11 90	19 8
8	13 36	22 2	13 44	22 4	13 52	22 5	13 60	22 6
9	15 03	25 0	15 12	25 2	15 21	25 3	15 30	25 5
10	16 70	27 8	16 80	28 0	16 90	28 1	17 00	28 3
11	18 37	30 6	18 48	30 8	18 59	30 9	18 70	31 1
12	20 04	33 4	20 16	33 6	20 28	33 8	20 40	34 0
13	21 71	36 1	21 84	36 4	21 97	36 6	22 10	36 8
14	23 38	38 9	23 52	39 2	23 66	39 4	23 80	39 6
15	25 05	41 7	25 20	42 0	25 35	42 2	25 50	42 5
16	26 72	44 5	26 88	44 8	27 04	45 0	27 20	45 3
17	28 39	47 3	28 56	47 6	28 73	47 8	28 90	48 1
18	30 06	50 1	30 24	50 4	30 42	50 7	30 60	51 0
19	31 73	52 8	31 92	53 2	32 11	53 5	32 30	53 8
20	33 40	55 6	33 60	56 0	33 80	56 3	34 00	56 6
21	35 07	58 4	35 28	58 8	35 49	59 1	35 70	59 5
22	36 74	61 2	36 96	61 6	37 18	61 9	37 40	62 3
23	38 41	64 0	38 64	64 4	38 87	64 7	39 10	65 1
24	40 08	66 8	40 32	67 2	40 56	67 6	40 80	68 0
25	41 75	69 5	42 00	70 0	42 25	70 4	42 50	70 8
26	43 42	72 3	43 68	72 8	43 94	73 2	44 20	73 6
27	45 09	75 1	45 36	75 6	45 63	76 0	45 90	76 5
28	46 76	77 9	47 04	78 4	47 32	78 8	47 60	79 3
29	48 43	80 7	48 72	81 2	49 01	81 6	49 30	82 1
30	50 10	83 5	50 40	84 0	50 70	84 5	51 00	85 0
40	66 80	111 3	67 20	112 0	67 60	112 6	68 00	113 3
50	83 50	139 1	84 00	140 0	84 50	140 8	85 00	141 6
100	167 00	278 3	168 00	280 0	169 00	281 6	170 00	283 3

No. of Bushels and Pounds.	AT 171 CENTS PER BUSHEL.		AT 172 CENTS PER BUSHEL.		AT 173 CENTS PER BUSHEL.		AT 174 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	1 71	2 8	1 72	2 8	1 73	2 8	1 74	2 9
2	3 42	5 7	3 44	5 7	3 46	5 7	3 48	5 8
3	5 13	8 5	5 16	8 6	5 19	8 6	5 22	8 7
4	6 84	11 4	6 88	11 4	6 92	11 5	6 96	11 7
5	8 55	14 2	8 60	14 3	8 65	14 4	8 70	14 5
6	10 26	17 1	10 32	17 2	10 38	17 3	10 44	17 4
7	11 97	19 9	12 04	20 0	12 11	20 1	12 18	20 3
8	13 68	22 8	13 76	22 9	13 84	23 0	13 92	23 2
9	15 39	25 6	15 48	25 8	15 57	25 9	15 66	26 1
10	17 10	28 5	17 20	28 6	17 30	28 8	17 40	29 0
11	18 81	31 3	18 92	31 5	19 03	31 7	19 14	31 9
12	20 52	34 2	20 64	34 4	20 76	34 6	20 88	34 8
13	22 23	37 0	22 36	37 2	22 49	37 4	22 62	37 7
14	23 94	39 9	24 08	40 1	24 22	40 3	24 36	40 6
15	25 65	42 7	25 80	43 0	25 95	43 2	26 10	43 5
16	27 36	45 6	27 52	45 8	27 68	46 1	27 84	46 4
17	29 07	48 4	29 24	48 7	29 41	49 0	29 58	49 3
18	30 78	51 3	30 96	51 6	31 14	51 9	31 32	52 2
19	32 49	54 1	32 68	54 4	32 87	54 7	33 06	55 1
20	34 20	57 0	34 40	57 3	34 60	57 6	34 80	58 0
21	35 91	59 8	36 12	60 2	36 33	60 5	36 54	60 9
22	37 62	62 7	37 84	63 0	38 06	63 4	38 28	63 8
23	39 33	65 5	39 56	65 9	39 79	66 3	40 02	66 7
24	41 04	68 4	41 28	68 8	41 52	69 2	41 76	69 6
25	42 75	71 2	43 00	71 6	43 25	72 0	43 50	72 5
26	44 46	74 1	44 72	74 5	44 98	74 9	45 24	75 4
27	46 17	76 9	46 44	77 4	46 71	77 8	46 98	78 3
28	47 88	79 8	48 16	80 2	48 44	80 7	48 72	81 2
29	49 59	82 6	49 88	83 1	50 17	83 6	50 46	84 1
30	51 30	85 5	51 60	86 0	51 90	86 5	52 20	87 0
40	68 40	114 0	68 80	114 6	69 20	115 3	69 60	116 0
50	85 50	142 5	86 00	143 3	86 50	144 1	87 00	145 0
100	171 00	285 0	172 00	286 6	173 00	288 3	174 00	290 0

No. of Bushels and Pounds.	AT 175 CENTS PER BUSHEL.		AT 176 CENTS PER BUSHEL.		AT 177 CENTS PER BUSHEL.		AT 178 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	1 75	2 9	1 76	2 9	1 77	2 9	1 78	2 9
2	3 50	5 8	3 52	5 8	3 54	5 9	3 56	5 9
3	5 25	8 7	5 28	8 8	5 31	8 8	5 34	8 9
4	7 00	11 6	7 04	11 7	7 08	11 8	7 12	11 8
5	8 75	14 5	8 80	14 6	8 85	14 7	8 90	14 8
6	10 50	17 5	10 56	17 6	10 62	17 7	10 68	17 8
7	12 25	20 4	12 32	20 5	12 39	20 6	12 46	20 7
8	14 00	23 3	14 08	23 4	14 16	23 6	14 24	23 7
9	15 75	26 2	15 84	26 4	15 93	26 5	16 02	26 7
10	17 50	29 1	17 60	29 3	17 70	29 5	17 80	29 6
11	19 25	32 0	19 36	32 2	19 47	32 4	19 58	32 6
12	21 00	35 0	21 12	35 2	21 24	35 4	21 36	35 6
13	22 75	37 9	22 88	38 1	23 01	38 3	23 14	38 5
14	24 50	40 8	24 64	41 0	24 78	41 3	24 92	41 5
15	26 25	43 7	26 40	44 0	26 55	44 2	26 70	44 5
16	28 00	46 6	28 16	46 9	28 32	47 2	28 48	47 4
17	29 75	49 5	29 92	49 8	30 09	50 1	30 26	50 4
18	31 50	52 5	31 68	52 8	31 86	53 1	32 04	53 4
19	33 25	55 4	33 44	55 7	33 63	56 0	33 82	56 3
20	35 00	58 3	35 20	58 6	35 40	59 0	35 60	59 3
21	36 75	61 2	36 96	61 5	37 17	61 9	37 38	62 3
22	38 50	64 1	38 72	64 5	38 94	64 9	39 16	65 2
23	40 25	67 0	40 48	67 4	40 71	67 8	40 94	68 2
24	42 00	70 0	42 24	70 4	42 48	70 8	42 72	71 2
25	43 75	72 9	44 00	73 3	44 25	73 7	44 50	74 1
26	45 50	75 8	45 76	76 2	46 02	76 7	46 28	77 1
27	47 25	78 7	47 52	79 2	47 79	79 6	48 06	80 1
28	49 00	81 6	49 28	82 1	49 56	82 6	49 84	83 0
29	50 75	84 5	51 04	85 0	51 33	85 5	51 62	86 0
30	52 50	87 5	52 80	88 0	53 10	88 5	53 40	89 0
40	70 00	116 6	70 40	117 3	70 80	118 0	71 20	118 6
50	87 50	145 8	88 00	146 6	88 50	147 5	89 00	148 3
100	175 00	291 6	176 00	293 3	177 00	295 0	178 00	296 6

No. of Bushels and Pounds.	AT 179 CENTS PER BUSHEL.		AT 180 CENTS PER BUSHEL.		AT 181 CENTS PER BUSHEL.		AT 182 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	1 79	2 9	1 80	3 0	1 81	3 0	1 82	3 0
2	3 58	5 9	3 60	6 0	3 62	6 0	3 64	6 0
3	5 37	8 9	5 40	9 0	5 43	9 0	5 46	9 1
4	7 16	11 9	7 20	12 0	7 24	12 0	7 28	12 1
5	8 95	14 9	9 00	15 0	9 05	15 0	9 10	15 1
6	10 74	17 9	10 80	18 0	10 86	18 1	10 92	18 2
7	12 53	20 8	12 60	21 0	12 67	21 1	12 74	21 2
8	14 32	23 8	14 40	24 0	14 48	24 1	14 56	24 2
9	16 11	26 8	16 20	27 0	16 29	27 1	16 38	27 3
10	17 90	29 8	18 00	30 0	18 10	30 1	18 20	30 3
11	19 69	32 8	19 80	33 0	19 91	33 1	20 02	33 3
12	21 48	35 8	21 60	36 0	21 72	36 2	21 84	36 4
13	23 27	38 7	23 40	39 0	23 53	39 2	23 66	39 4
14	25 06	41 7	25 20	42 0	25 34	42 2	25 48	42 4
15	26 85	44 7	27 00	45 0	27 15	45 2	27 30	45 5
16	28 64	47 7	28 80	48 0	28 96	48 2	29 12	48 5
17	30 43	50 7	30 60	51 0	30 77	51 2	30 94	51 5
18	32 22	53 7	32 40	54 0	32 58	54 3	32 76	54 6
19	34 01	56 6	34 20	57 0	34 39	57 3	34 58	57 6
20	35 80	59 6	36 00	60 0	36 20	60 3	36 40	60 6
21	37 59	62 6	37 80	63 0	38 01	63 3	38 22	63 7
22	39 38	65 6	39 60	66 0	39 82	66 3	40 04	66 7
23	41 17	68 6	41 40	69 0	41 63	69 3	41 86	69 7
24	42 96	71 6	43 20	72 0	43 44	72 4	43 68	72 8
25	44 75	74 5	45 00	75 0	45 25	75 4	45 50	75 8
26	46 54	77 5	46 80	78 0	47 06	78 4	47 32	78 8
27	48 33	80 5	48 60	81 0	48 87	81 4	49 14	81 9
28	50 12	83 5	50 40	84 0	50 68	84 4	50 96	84 9
29	51 91	86 5	52 20	87 0	52 49	87 4	52 78	87 9
30	53 70	89 5	54 00	90 0	54 30	90 5	54 60	91 0
40	71 60	119 3	72 00	120 0	72 40	120 6	72 80	121 3
50	89 50	149 1	90 00	150 0	90 50	150 8	91 00	151 6
100	179 00	298 3	180 00	300 0	181 00	301 6	182 00	303 3

No. of Bushels and Pounds.	AT 183 CENTS PER BUSHEL.		AT 184 CENTS PER BUSHEL.		AT 185 CENTS PER BUSHEL.		AT 186 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	1 83	3 0	1 84	3 0	1 85	3 0	1 86	3 1
2	3 66	6 1	3 68	6 1	3 70	6 1	3 72	6 2
3	5 49	9 1	5 52	9 2	5 55	9 2	5 58	9 3
4	7 32	12 2	7 36	12 2	7 40	12 3	7 44	12 4
5	9 15	15 2	9 20	15 3	9 25	15 4	9 30	15 5
6	10 98	18 3	11 04	18 4	11 10	18 5	11 16	18 6
7	12 81	21 3	12 88	21 4	12 95	21 5	13 02	21 7
8	14 64	24 4	14 72	24 5	14 80	24 6	14 88	24 8
9	16 47	27 4	16 56	27 6	16 65	27 7	16 74	27 9
10	18 30	30 5	18 40	30 6	18 50	30 8	18 60	31 0
11	20 13	33 5	20 24	33 7	20 35	33 9	20 46	34 1
12	21 96	36 6	22 08	36 8	22 20	37 0	22 32	37 2
13	23 79	39 6	23 92	39 8	24 05	40 0	24 18	40 3
14	25 62	42 7	25 76	42 9	25 90	43 1	26 04	43 4
15	27 45	45 7	27 60	46 0	27 75	46 2	27 90	46 5
16	29 28	48 8	29 44	49 0	29 60	49 3	29 76	49 6
17	31 11	51 8	31 28	52 1	31 45	52 4	31 62	52 7
18	32 94	54 9	33 12	55 2	33 30	55 5	33 48	55 8
19	34 77	57 9	34 96	58 2	35 15	58 5	35 34	58 9
20	36 60	61 0	36 80	61 3	37 00	61 6	37 20	62 0
21	38 43	64 0	38 64	64 4	38 85	64 7	39 06	65 1
22	40 26	67 1	40 48	67 4	40 70	67 8	40 92	68 2
23	42 09	70 1	42 32	70 5	42 55	70 9	42 78	71 3
24	43 92	73 2	44 16	73 6	44 40	74 0	44 64	74 4
25	45 75	76 2	46 00	76 6	46 25	77 0	46 50	77 5
26	47 58	79 3	47 84	79 7	48 10	80 1	48 36	80 6
27	49 41	82 3	49 68	82 8	49 95	83 2	50 22	83 7
28	51 24	85 4	51 52	85 8	51 80	86 3	52 08	86 8
29	53 07	88 4	53 36	88 9	53 65	89 4	53 94	89 9
30	54 90	91 5	55 20	92 0	55 50	92 5	55 88	93 1
40	73 20	122 0	73 60	122 6	74 00	123 3	74 40	124 0
50	91 50	152 5	92 00	153 3	92 50	154 1	93 00	155 0
100	183 00	305 0	184 00	306 6	185 00	308 3	186 00	310 0

No. of Bushels and Pounds.	AT 187 CENTS PER BUSHEL.		AT 188 CENTS PER BUSHEL.		AT 189 CENTS PER BUSHEL.		AT 190 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	1 87	3 1	1 88	3 1	1 89	3 1	1 90	3 1
2	3 74	6 2	3 76	6 2	3 78	6 3	3 80	6 3
3	5 61	9 3	5 64	9 4	5 67	9 4	5 70	9 5
4	7 48	12 4	7 52	12 5	7 56	12 6	7 60	12 6
5	9 35	15 5	9 40	15 6	9 45	15 7	9 50	15 8
6	11 22	18 7	11 28	18 8	11 34	18 9	11 40	19 0
7	13 09	21 8	13 16	21 9	13 23	22 0	13 30	22 1
8	14 96	24 9	15 04	25 0	15 12	25 2	15 20	25 3
9	16 83	28 0	16 92	28 2	17 01	28 3	17 10	28 5
10	18 70	31 1	18 80	31 3	18 90	31 5	19 00	31 6
11	20 57	34 2	20 68	34 4	20 79	34 6	20 90	34 8
12	22 44	37 4	22 56	37 6	22 68	37 8	22 80	38 0
13	24 31	40 5	24 44	40 7	24 57	40 9	24 70	41 1
14	26 18	43 6	26 32	43 8	26 46	44 1	26 60	44 3
15	28 05	46 7	28 20	47 0	28 35	47 2	28 50	47 5
16	29 92	49 8	30 08	50 1	30 24	50 4	30 40	50 6
17	31 79	52 9	31 96	53 2	32 13	53 5	32 30	53 8
18	33 66	56 1	33 84	56 4	34 02	56 7	34 20	57 0
19	35 53	59 2	35 72	59 5	35 91	59 8	36 10	60 1
20	37 40	62 3	37 60	62 6	37 80	63 0	38 00	63 3
21	39 27	65 4	39 48	65 8	39 69	66 1	39 90	66 5
22	41 14	68 5	41 36	68 9	41 58	69 3	41 80	69 6
23	43 01	71 6	43 24	72 0	43 47	72 4	43 70	72 8
24	44 88	74 8	45 12	75 2	45 36	75 6	45 60	76 0
25	46 75	77 9	47 00	78 3	47 25	78 7	47 50	79 1
26	48 62	81 0	48 88	81 4	49 14	81 9	49 40	82 3
27	50 49	84 1	50 76	84 6	51 03	85 0	51 30	85 5
28	52 36	87 2	52 64	87 7	52 92	88 2	53 20	88 6
29	54 23	90 3	54 52	90 8	54 81	91 3	55 10	91 8
30	56 10	93 5	56 40	94 0	56 70	94 5	57 00	95 0
40	74 80	124 6	75 20	125 3	75 60	126 0	76 00	126 6
50	93 50	155 8	94 00	156 6	94 50	157 5	95 00	158 3
100	187 00	311 6	188 00	313 3	189 00	315 0	190 00	316 6

No. of Bushels and Pounds.	AT 191 CENTS PER BUSHEL.		AT 192 CENTS PER BUSHEL.		AT 193 CENTS PER BUSHEL.		AT 194 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	1 91	3 1	1 92	3 2	1 93	3 2	1 94	3 2
2	3 82	6 3	3 84	6 4	3 86	6 4	3 88	6 4
3	5 73	9 5	5 76	9 6	5 79	9 6	5 82	9 7
4	7 64	12 7	7 68	12 8	7 72	12 8	7 76	12 9
5	9 55	15 9	9 60	16 0	9 65	16 0	9 70	16 1
6	11 46	19 1	11 52	19 2	11 58	19 3	11 64	19 4
7	13 37	22 2	13 44	22 4	13 51	22 5	13 58	22 6
8	15 28	25 4	15 36	25 6	15 44	25 7	15 52	25 8
9	17 19	28 6	17 28	28 8	17 37	28 9	17 46	29 1
10	19 10	31 8	19 20	32 0	19 30	32 1	19 40	32 3
11	21 01	35 0	21 12	35 2	21 23	35 3	21 34	35 5
12	22 92	38 2	23 04	38 4	23 16	38 6	23 28	38 8
13	24 83	41 3	24 96	41 6	25 09	41 8	25 22	42 0
14	26 74	44 5	26 88	44 8	27 02	45 0	27 16	45 2
15	28 65	47 7	28 80	48 0	28 95	48 2	29 10	48 5
16	30 56	50 9	30 72	51 2	30 88	51 4	31 04	51 7
17	32 47	54 1	32 64	54 4	32 81	54 6	32 98	54 9
18	34 38	57 3	34 56	57 6	34 74	57 9	34 92	58 2
19	36 29	60 4	36 48	60 8	36 67	61 1	36 86	61 4
20	38 20	63 6	38 40	64 0	38 60	64 3	38 80	64 6
21	40 11	66 8	40 32	67 2	40 53	67 5	40 74	67 9
22	42 02	70 0	42 24	70 4	42 46	70 7	42 68	71 1
23	43 93	73 2	44 16	73 6	44 39	73 9	44 62	74 3
24	45 84	76 4	46 08	76 8	46 32	77 2	46 56	77 6
25	47 75	79 5	48 00	80 0	48 25	80 4	48 50	80 8
26	49 66	82 7	49 92	83 2	50 18	83 6	50 44	84 0
27	51 57	85 9	51 84	86 4	52 11	86 6	52 38	87 3
28	53 48	89 1	53 76	89 6	54 04	90 0	54 32	90 5
29	55 39	92 3	55 68	92 8	55 97	93 2	56 26	93 7
30	57 30	95 5	57 60	96 0	57 90	96 5	58 20	97 0
40	76 40	127 3	76 80	128 0	77 20	128 6	77 60	129 3
50	95 50	159 1	96 00	160 0	96 50	160 8	97 00	161 6
100	191 00	318 3	192 00	320 0	193 00	321 6	194 00	323 3

No. of Bushels and Pounds.	AT 195 CENTS PER BUSHEL.		AT 196 CENTS PER BUSHEL.		AT 197 CENTS PER BUSHEL.		AT 198 CENTS PER BUSHEL.	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	1 95	3 2	1 96	3 2	1 97	3 2	1 98	3 3
2	3 90	6 5	3 92	6 5	3 94	6 5	3 96	6 6
3	5 85	9 7	5 88	9 8	5 91	9 8	5 94	9 9
4	7 80	13 0	7 84	13 0	7 88	13 1	7 92	13 2
5	9 75	16 2	9 80	16 3	9 85	16 4	9 90	16 5
6	11 70	19 5	11 76	19 6	11 82	19 7	11 88	19 8
7	13 65	22 7	13 72	22 8	13 79	22 9	13 86	23 1
8	15 60	26 0	15 68	26 1	15 76	26 2	15 84	26 4
9	17 55	29 2	17 64	29 4	17 73	29 5	17 82	29 7
10	19 50	32 5	19 60	32 6	19 70	32 8	19 80	33 0
11	21 45	35 7	21 56	35 9	21 67	36 1	21 78	36 3
12	23 40	39 0	23 52	39 2	23 64	39 4	23 76	39 6
13	25 35	42 2	25 48	42 4	25 61	42 6	25 74	42 9
14	27 30	45 5	27 44	45 7	27 58	45 9	27 72	47 2
15	29 25	48 7	29 40	49 0	29 55	49 2	29 70	49 5
16	31 20	52 0	31 36	52 2	31 52	52 5	31 68	52 8
17	33 15	55 2	33 32	55 5	33 49	55 8	33 66	56 1
18	35 10	58 5	35 28	58 8	35 46	59 1	35 64	59 4
19	37 05	61 7	37 24	62 0	37 43	62 3	37 62	62 7
20	39 00	65 0	39 20	65 3	39 40	65 6	39 60	66 0
21	40 95	68 2	41 16	68 6	41 37	68 9	41 58	69 3
22	42 90	71 5	43 12	71 8	43 34	72 2	43 56	72 6
23	44 85	74 7	45 08	75 1	45 31	75 5	45 54	75 9
24	46 80	78 0	47 04	78 4	47 28	78 8	47 52	79 2
25	48 75	81 2	49 00	81 6	49 25	82 0	49 50	82 5
26	50 70	84 5	50 96	84 9	51 22	85 3	51 48	85 8
27	52 65	87 7	52 92	88 2	53 19	88 6	53 46	89 1
28	54 60	91 0	54 88	91 4	55 16	91 9	55 44	92 4
29	56 55	94 2	56 84	94 7	57 13	95 2	57 42	95 7
30	58 50	97 5	58 80	98 0	59 10	98 5	59 40	99 0
40	78 00	130 0	78 40	130 6	78 80	131 3	79 20	132 0
50	97 50	162 5	98 00	163 3	98 50	164 1	99 00	165 0
100	195 00	325 0	196 00	326 6	197 00	328 3	198 00	330 0

No. of Bushels and Pounds.	AT 199 CENTS PER BUSHEL.		AT 200 CENTS PER BUSHEL	
	Value per Bushel.	Value per Pound.	Value per Bushel.	Value per Pound.
	Dolls. Cts.	Cts. Mills.	Dolls. Cts.	Cts. Mills.
1	1 99	3 3	2 00	3 3
2	3 98	6 6	4 00	6 6
3	5 97	9 9	6 00	10 0
4	7 96	13 2	8 00	13 3
5	9 95	16 5	10 00	16 6
6	11 94	19 9	12 00	20 0
7	13 93	23 2	14 00	23 3
8	15 92	26 5	16 00	26 6
9	17 91	29 8	18 00	30 0
10	19 90	33 1	20 00	33 3
11	21 89	36 4	22 00	36 6
12	23 88	39 8	24 00	40 0
13	25 87	43 1	26 00	43 3
14	27 86	46 4	28 00	46 6
15	29 85	49 7	30 00	50 0
16	31 84	53 0	32 00	53 3
17	33 83	56 3	34 00	56 6
18	35 82	59 7	36 00	60 0
19	37 81	63 0	38 00	63 3
20	39 80	66 3	40 00	66 6
21	41 79	69 6	42 00	70 0
22	43 78	72 9	44 00	73 3
23	45 77	76 2	46 00	76 6
24	47 76	79 6	48 00	80 0
25	49 75	82 9	50 00	83 3
26	51 74	86 2	52 00	86 6
27	53 73	89 5	54 00	90 0
28	55 72	92 8	56 00	93 3
29	57 71	96 1	58 00	96 6
30	59 70	99 5	60 00	100 0
40	79 60	132 6	80 00	133 3
50	99 50	165 8	100 00	166 6
100	199 00	331 6	200 00	333 3

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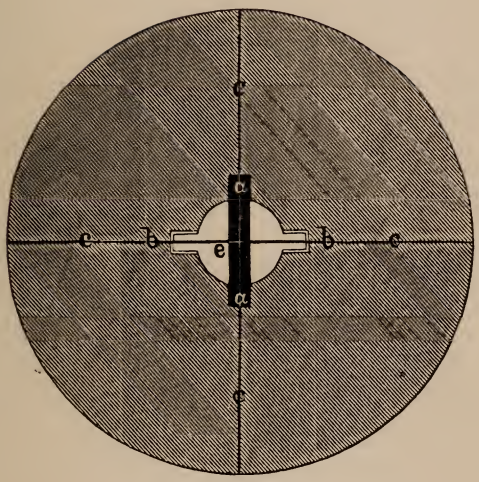
THE END.

PLATE I.

SCALE OF HALF AN INCH TO THE FOOT.

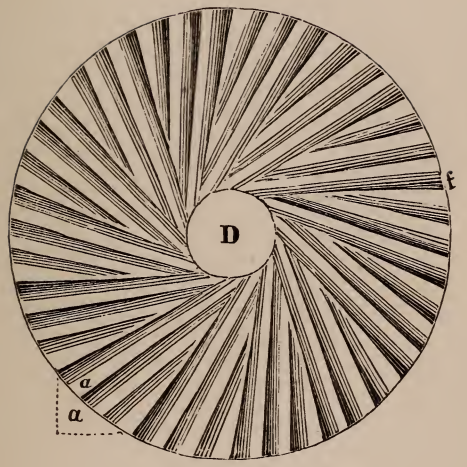
e. The eye of the Stone.
a. The Circle Line pitched into six equal parts.
b b b. The three Beds for taking the Stone out of wind.

PLATE II.



a a. The Balance Ryne.
b b. The Driver Boxes.
c c c c. The Centre Lines.
e. The Eye of the Stone.

PLATE III.

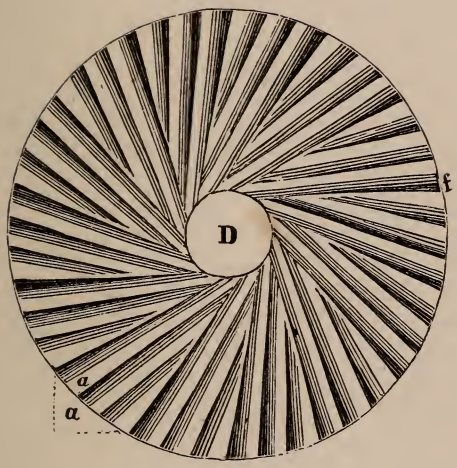


THE BED STONE.

PLATE IV.

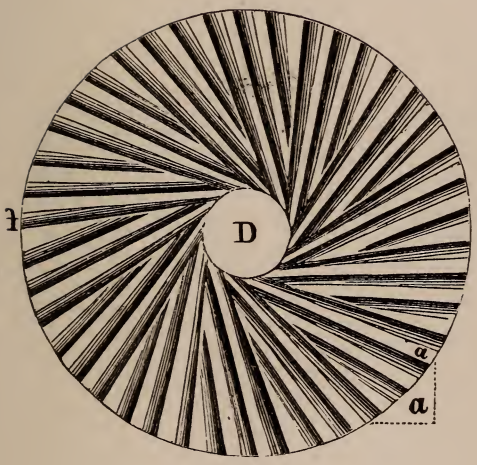
THE TRANSPARENCY.

PLATE V.



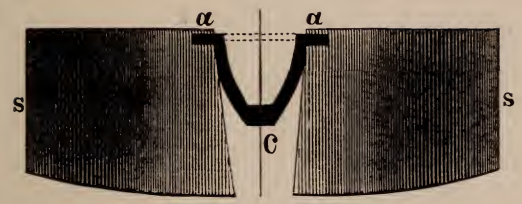
THE RUNNING STONE.

PLATE VI.



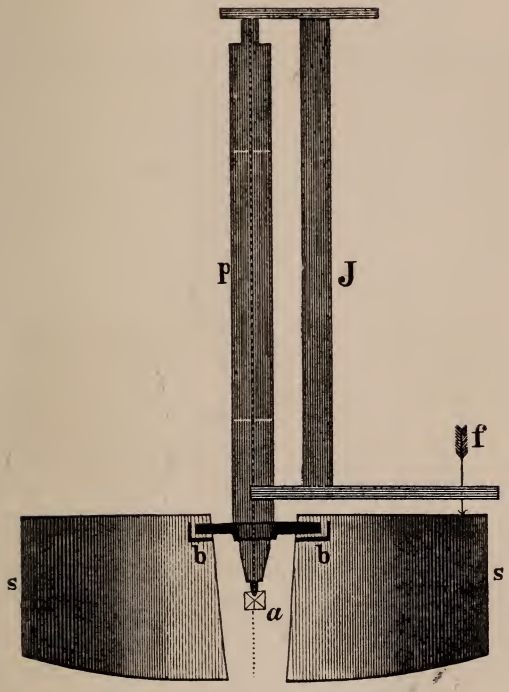
TO RUN AGAINST THE SUN.

PLATE VII.



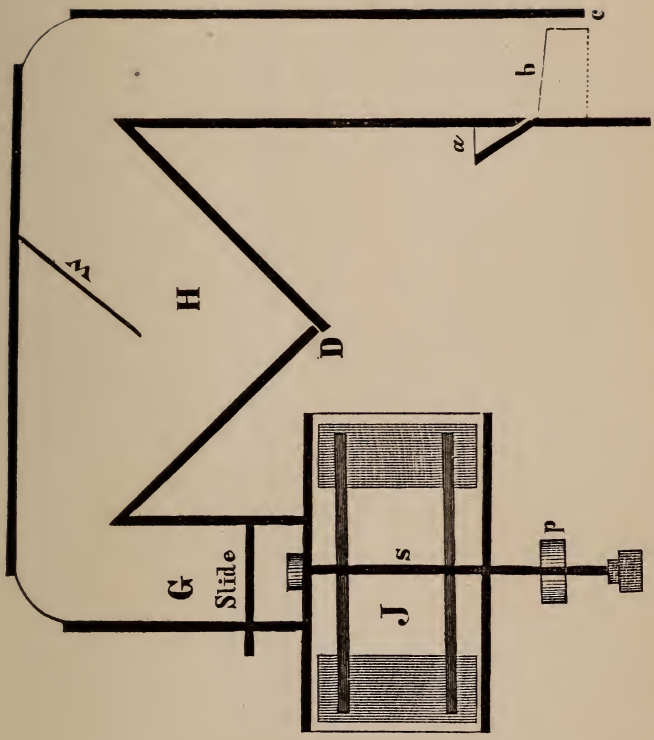
a a. The Balance Ryne.
c. The Centre of the Stone.
s s. The Mill Stone.

PLATE VIII.

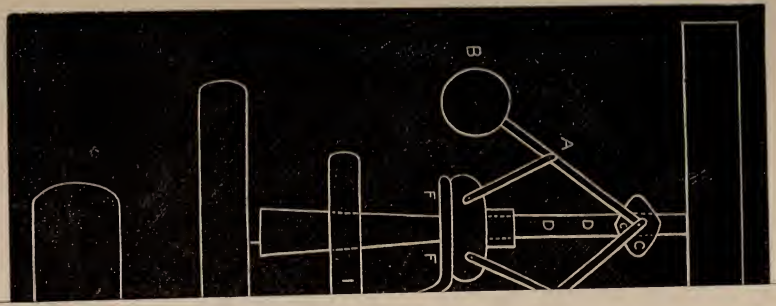


s s. The Mill Stone.
a. The Balance Ryne.
b b. The Driver and Boxes.
p. The Spindle.
J. The Tram.
f. The Quill.

PLATE IX.



SUCTION FAN.


B
A
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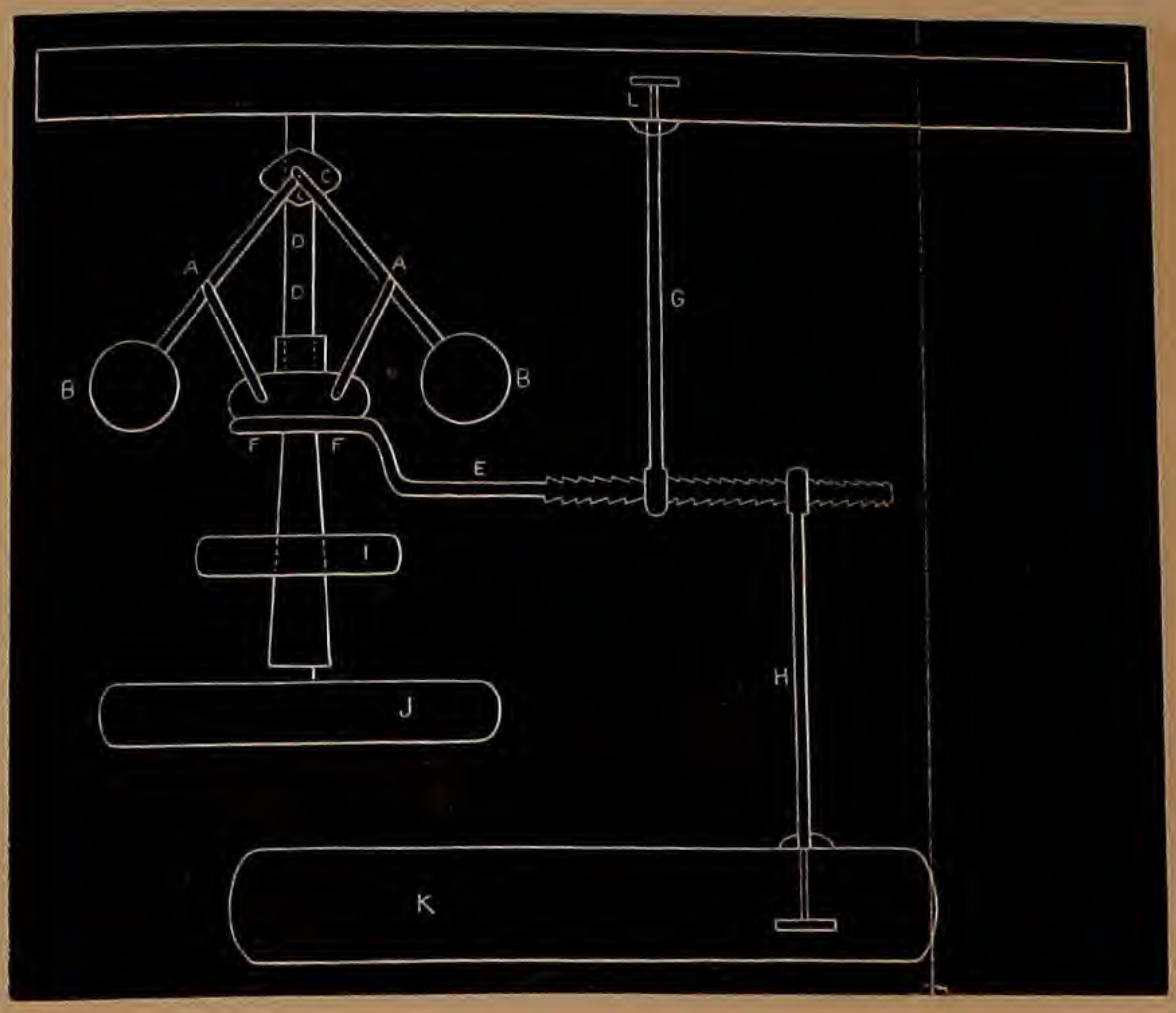
D
C
C

PLATE X.



GOVERNOR.

ADVERTISEMENTS.

STOUT, MILLS & TEMPLE,

LUDLOW ST., DAYTON, OHIO,

Four squares South of the Union Passenger Depot,

FOUNDERS & MACHINISTS,

PATENTEES AND MANUFACTURERS OF THE

TURBINE WATER-WHEEL,

AND ALL DESCRIPTIONS OF

MILL MACHINERY AND GENERAL MILL FURNISHING GOODS.

These Wheels and Cases possess important features in the application of water, which no other wheels do. There are six or more graduated shutes on these wheels, depending on the diameter. Each gate and shute is cast in one piece, and moves horizontally—the shute being hinged at the point near the inside of the case or point of depletion. Thus, as the gate is opened or closed, the shutes move with the gates. Behind the shute is a guard, which is cast between the upper and lower plates of the case. This guard relieves the gate from the hydrostatic pressure of the head; consequently, the gates are easily opened and closed by means of a ring and levers, operated by a segment and pinion. The gate rod, on which the pinion is placed, passes up through the husk or floor, with a hand-wheel on the upper end for the purpose of operating the gates.

Whether the gates are fully or partially opened, the shutes are always adjusted to suit the amount of water admitted through the gates. Therefore, the wheel will produce as high a per cent. of power with a half as with a full gate.

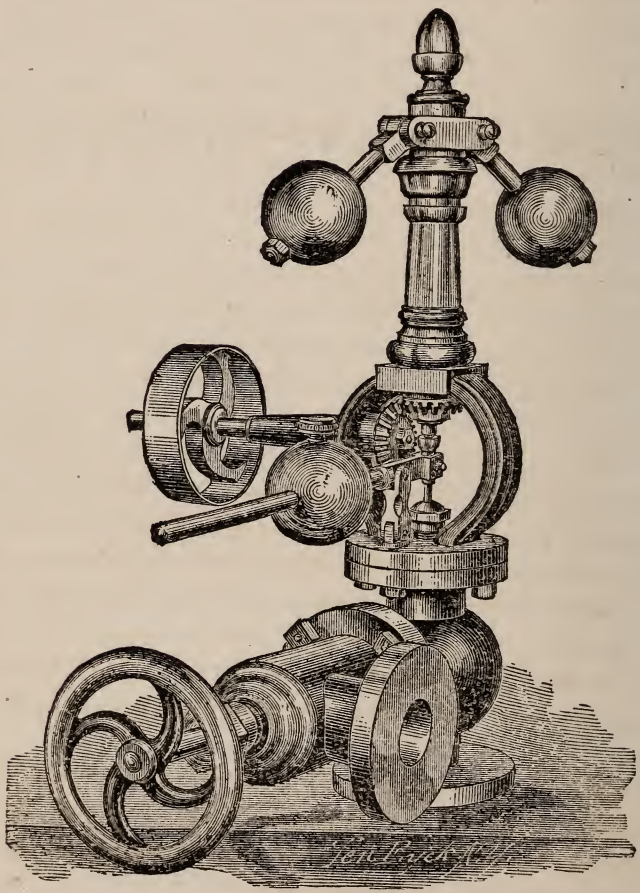
These Wheels are made strong and durable, give a high per cent. of power, and are guaranteed to give full satisfaction. All parts of Wheels and Cases are well fitted—the shutes are ground off smooth, and when they leave the shop are ready to set in a penstock, requiring but a small amount of labor to set them up, which any intelligent mechanic can do with the assistance of printed directions, which will be found in our printed Circulars. We are making eleven sizes, from 12 to 66 inches diameter, producing from one to three hundred and fifty horse-power, according to the diameter of the wheel and height of fall under which they are placed. Orders filled promptly. We will be pleased to send by mail to those interested, a descriptive Catalogue of Water-Wheels, Mill Machinery, etc.

We will prosecute parties who infringe our rights in the use or manufacture of our Ring and Levers, Case Guards, Knuckle Joints, Graduated Shutes, or claims on Water-Wheels.

The author believes this Turbine Wheel one of the best now in use. It has been thoroughly tested by Messrs. Sohl & Co., at their Mills, Indianapolis, Indiana, with the Leffell Wheel—the Dayton Wheel taking considerably less water to do the same amount of work.

GARDNER'S

COMPENSATION GOVERNOR.



This Governor has many advantages over most, and many distinct features over all regulators of the steam-engine now in use, as regards both action and durability. The leading advantages in this Governor are sensitiveness without oscillation, absence of lost motion produced by wear, and the facility of changing the speed of the engine, without change of

belts and without stopping the engine, and involving a very small amount of friction. Additional improvements have lately been added, by which the steam is shut off automatically in case of any accident stopping the rotary motion of the engine, or stopping the governor belt.

In this Governor the valve stem and governor stem are entirely detached; the valve is closed by the centrifugal force extended by the balls on the rovolving arms, and opened by the gravitation of the adjustable ball on the lever working over a fulcrum. There is a constant pressure of gravitation operating against the varying pressure of the centrifugal force. This pressure is received on a steel toe working in a taleon cup, dispensing with all inside joints and connections, and as the pressure is constant on all the bearing surfaces there is never any lost motion to take up, the motion of the centrifugal balls being conveyed direct to the valve.

The speed of the engine is varied by moving the adjustable weight so as to give a greater or less resistance to the centrifugal power.

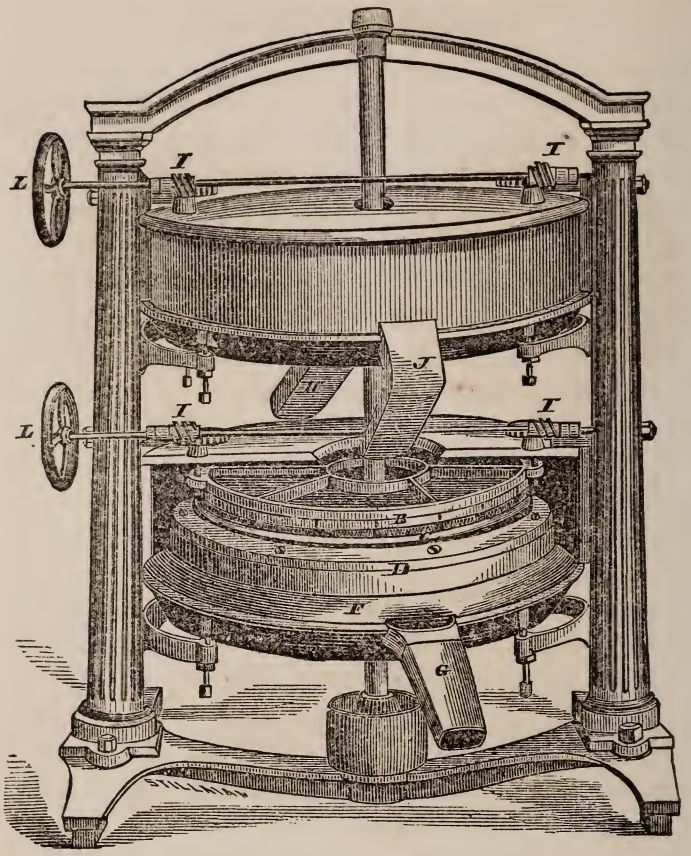
In this arrangement, it will be seen that a large amount of centrifugal force is developed without the necessity of carrying heavy balls (these balls are hollow and light), and also gives an increased speed to the Governor; and as the gravitation of the centrifugal balls is not requisite to the opening of the valve, it overcomes the difficulty noticed in most Governors of the inclination of the balls to revolve in the same plane, and when the motion decreases the balls seem to hang and then fall sluggishly, allowing the engine to drop considerably below the speed, before the valve is opened to admit sufficient steam. The valve is tubular, balanced perfectly, and free from friction, having a parallel opening and a very short travel.

These Governors have now been in use for the last four years, and are fast coming into general use. They are well made and neatly designed.

This Governor is the invention of Robt. N. Gardner, and was patented August 14th, 1860, and is manufactured by

GARDNER & ROBERTSON,
of Quincy, Illinois, and

HOFF & FOUNTAINE,
Philadelphia, Pa.



THE UNDERSIGNED BEG LEAVE TO CALL YOUR ATTENTION TO THEIR

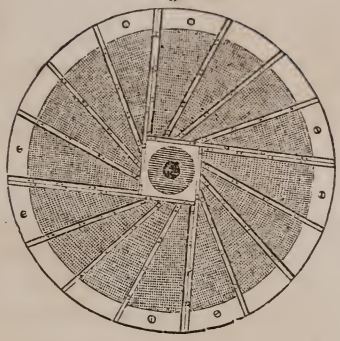
EXCELSIOR BOLT DUSTER!

Patented February 12th, 1861.

Fig. 1 represents the Machine with half of lower casing removed. Fig. 2 is a face view of the brush head B, and tempering wheel C. Fig. 3 is a face view of the cloth wheel. Fig. 4 is a section of the cloth wheel. The brush head B hangs upon the lighter screws E E, and is composed of 15 brushes, screwed on to an iron frame, with intermediate spaces between, to admit the arm of the tempering wheel C, which wheel also regulates

Fig. 2.

Fig. 3.



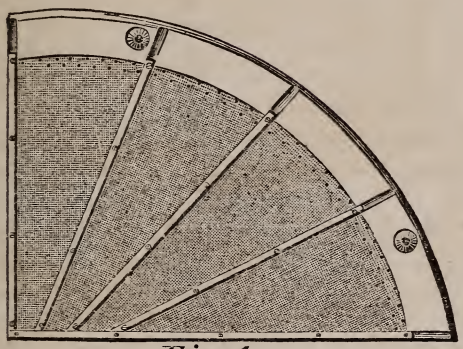


Fig. 4.

the depth of the furrows, and the elasticity or stiffness of the brushes. The disk screen or cloth wheel, Fig. 3, is an iron wheel, provided on its under side with fan blades, and to its upper side the cloth frames are attached by screw bolts; the cloth wheel is keyed on to the shaft and revolves within and above the air chamber F, and also beneath the stationary brush head B. The air chamber F has an opening on its under side, near the periphery, to which is attached the Flour spout G. Hence it is obvious that the evolution of the fans on the cloth wheel in the air chamber, must necessarily produce a blast at the spout G, and a downward suction through the meshes of the cloth, to supply the vacuum in the air chamber E, created by the blast at G.

The principle upon which the machine acts is as follows: The Bran runs in the eye of the Machine; from there it passes through the eye of the stationary brush head B, on to the centre of the revolving cloth wheel D, the centrifugal force of which gradually forwards it outward to the periphery, where it is discharged at the bran spout H. The upper bran

spout returns into the eye of the lower duster, where the same operation is repeated. The surfaces of the cloth and brush are perfectly level and true, the bran in passing between the two is equally distributed over the cloth wheel, and at the same time is thoroughly scoured by the brushes. The fine particles of flour, as fast as they become detached from the bran are taken through the cloth, by the suction, into the air chamber F, and are discharged at spout G.

This Machine is nearly all constructed of iron, is very simple in its operation, takes but little power to run it, and is very durable. The brushes in this Machine are so protected by the tempering wheel C, that there is not any perceivable wear in several months' constant use. The cloth used in these Machines is a very superior article, and is manufactured expressly for our use.

The principal advantages claimed for this Machine over all others are as follows: First, we can make a better article of Flour from the bran or offal, than can be produced by any other machine. Second, we get a much larger quantity of flour, consequently better yields. Third, the machine, while in motion, can be graduated by the miller, with the lighter screws, to take out more or less. Fourth, there is no need of any duster reels, and very little return cloth; consequently, where these machines are used there is a great saving in machinery, power, and room. Fifth, it makes but few middlings, and what there is are clean and sharp for re-grinding. To parties engaged in manufacturing high grades of flour these machines are expressly adapted, as there is no difficulty in making yields, without reducing the quality.

Parties using these Machines frequently run their yields down to four bushels to the barrel. The saving to millers with this Machine is from ten to fifteen pounds of wheat per barrel. Satisfactory evidence and reference given of this fact.

The price of our Machine, capacity for Cleaning the offal from 200 barrels per day, is $450. A competent man will be sent with the Machine to see that it is put up in good order. Machines are guaranteed to do all we represent, or NO PAY.

For further information, address

CLARK, ELTING & CO.,

Buffalo, N. Y. Box 711.

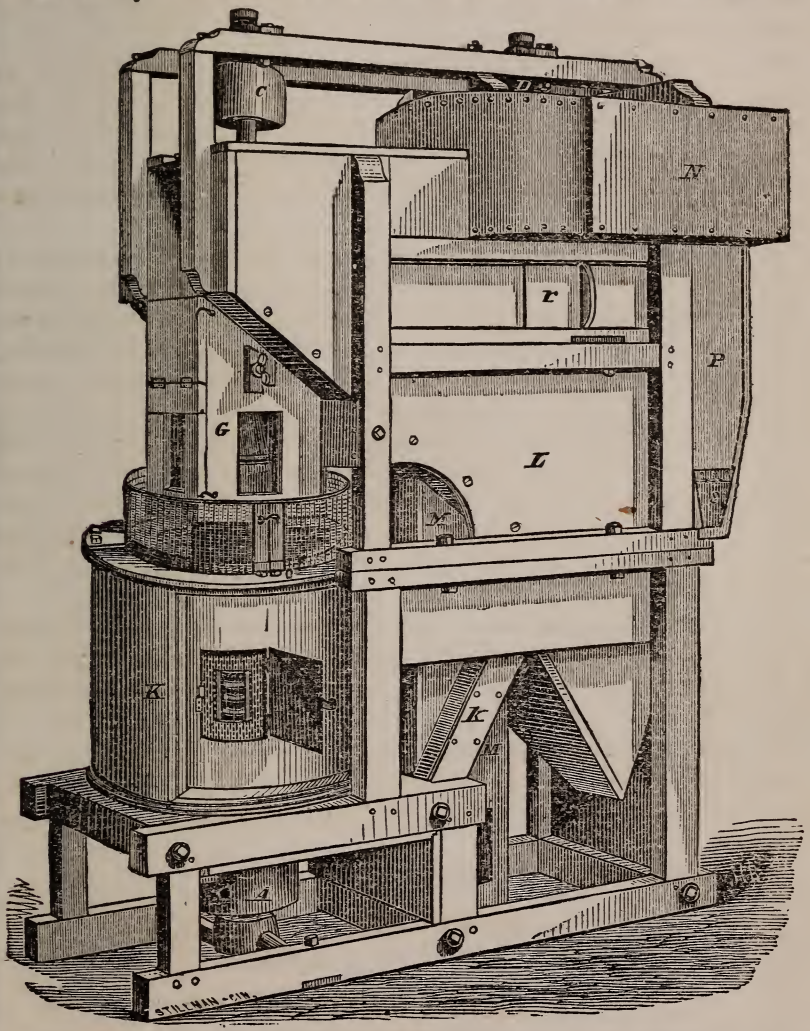
CLARK, ELTING & CO.,

214 *Columbia St., Cincinnati, O.*

A. J. VANDEGRIFT'S

CENTRIFUGAL FEEDING DOUBLE SUCTION SEPARATOR & SMUTTER COMBINED.

Manufactured by the Inventor, at No. 169 West Second St., Cincinnati, Ohio, and also by A. K. Halteman, Carondelet Av. & Carrol St., St. Louis, Mo.



This Machine was awarded the First Premium at the Fifth and Last Great Annual State and National Fair, held in St. Louis, Mo., in September, 1860; and also at the Ohio State Fair, held in Cleveland, 1863.

A. J. Vandegrift is the inventor of the application of a Revolving Plate,

for the purpose of spreading grain horizontally in a thin sheet across the refreshing current of air in the flues to Suction Separators, which was patented by him in June, 1858. This arrangement, for feeding grain in air flues properly constructed for the purpose, renders the separation of the impurities from grain as perfect as it can possibly be done, on the principle of taking advantage of the difference in relative specific gravity, which is generally conceded to be the proper one.

The above Cut represents a perspective view of *Vandegrift's Centrifugal Feeding Separator and Smutter Combined*, as improved and patented by him, in July, 1860. When combined, as represented by the Cut, this Machine is so constructed, that the grain being spouted in at the top, passes down through a feed tube which encircles the shaft on to a revolving plate which, by its rotary motion, throws the grain off across the suction current in such a manner, spreading it through all parts of the flue alike, that the smut balls and all other impurities lighter than the grain itself, are floated out in the most perfect manner before the grain enters the scouring operator, which is also of a very superior construction, the outside case being composed of alternate sections of open, free tempered, old stock French burr, and heavy perforated sheet-iron, which is so arranged, that as fast as the dust and fibrous coating is detached from the grain, it is ejected through the perforations in the sheet-iron sections of the case on either side into spaces properly arranged for the purpose, and is drawn away by the full force of the fan and is blown out of the mill-house, the grain passing thence into another flue, where it is subjected to another strong suction current, and passes away from the Machine in complete order for grinding, the offal being divested of all dust, being also re-separated and graded as it passes from the Machine, renders it capable of being set in any part of the mill most convenient, there being no dust accumulating about it. This Machine was first introduced by the inventor into the Flouring Mills in the city of St. Louis, during the summer of 1858, the first Machine being put up in the Saxony Mills, for Messrs. Leonhardt & Schuricht, which they have now been running five years, having cleaned nine hundred and fifty thousand bushels of wheat through it. The total expense of repairs on this Machine has been $13.10, and it is now in good order, and capable of cleaning one hundred bushels per hour, in the most perfect manner. This Machine has been very generally adopted by the first-class Mills in the city of St. Louis and surrounding country. It is used by the following Mills in the city:

Saxony Mills.	**St. George Mills.**	**Phoenix Mills.**
Star Mills.	**Park Mills.**	**Planter's Mills.**
O'Fallon Mills.	**Empire Mills.**	**Atlantic Mills.**

The manufacturers build six different sizes of this Machine, with capacities ranging from 15 bushels to 150 bushels per hour—they also build various sizes of Centrifugal Feeding Suction Separators, without the Scouring Operators, to order. The inventor is now being very successful in introducing these Machines into Flouring Mills, and also his Separators, of very large size, to run in connection with Shipping Elevators, in the city of Cincinnati and surrounding country.

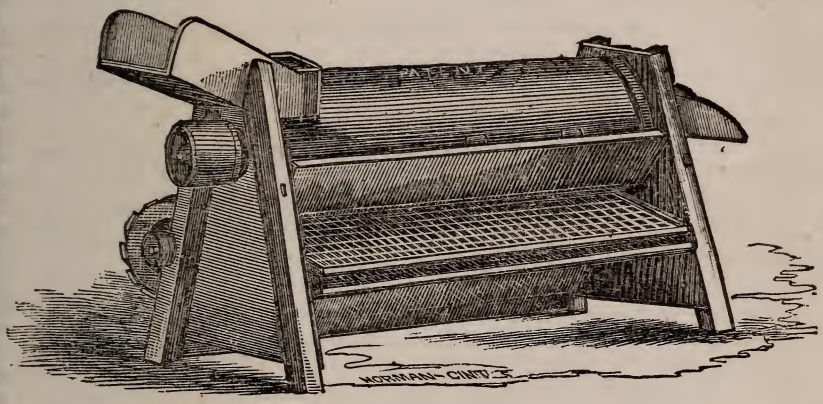
Persons interested can obtain Circulars, containing full particulars, by calling on, or addressing

A. J. VANDEGRIFT,
No. 169 W. Second St., Cincinnati, O., or
A. K. HALTEMAN,
Carondelet Av. and Carrol St., St. Louis, Mo.

PREMIUM POWER

CORN SHELLER & CLEANER.

READING'S PATENT.



THIS MACHINE HAS TAKEN THE FIRST PREMIUM AT TWENTY DIFFERENT FAIRS.

In fact at every Fair at which it has been exhibited. It is warranted in every point superior to any other Sheller now in use. It is very simple in its construction, and also very durable; has not a cog wheel about it. One advantage it has over other Power Shellers is in the permanency, size, and durability of the teeth, being very large and made solid in the Cylinder. This machine, unlike all other Shellers, *does not shell against a rest*, but entirely by friction; the Cylinder is not nearer the case than four inches in any position, consequently if a stone, piece of iron, or any hard substance gets into the machine when running it does not injure it, but presses it in among the cobs, and passes out with them without any injury to the machine. We build three sizes, as follows:

No. 1 Plain Sheller, capacity 1,500 to 2,500 bushels per day.

No. 2 Sheller and Cleaner, capacity 600 to 1000 bushels per day, 4 Horse-Power.

No. 3 Plain Sheller, capacity 500 to 800 bushels per day, 4 Horse-Power.

Our No. 1 is best adapted to distillery use, being built extra heavy and strong. Our Sheller and Cleaner fans, riddles and cleans the corn ready

for market. Below we give a few certificates from persons who are now using our Shellers; we can give a large number equally as strong as the following if required. For further information address the manufacturers, they being prepared to fill orders for all kinds of Agricultural Implements and Machinery; also, dealers in all kinds of Field and other Seed, Fruit and ornamental Trees, etc., etc.

J. WILDER & CO.,

Manufacturers and Dealers, 230 *Walnut St., Cincinnati, O.*

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